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JPRS 81156

29 JUNE 1982

China Report

ECONOMIC AFFAIRS

No. 243

ENERGY: STATUS AND DEVELOPMENT --VI

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CHINA REPORT

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ENERGY: STATUS AND DEVELOPMENT --VI

CONTENTS

CONSERVATION IS CORNERSTONE OF CURRENT ENERGY POLICY

Beijing NENG YUAN [JOURNAL OF ENERGY] No 1, 25 Feb 82 pp 1-4

[Article by Luo Hongda (5012 1347 6671), National Energy Commission Planning Bureau: "Talks on China's National Energy Policy"]

[Text] If we want to solve China's energy problem, we must formulate an appropriate energy policy. In the summer of 1980, the Government established strategic guidelines concerning energy: "Development and conservation should be emphasized equally. For the short term, conservation should take first place." These guidelines took into consideration China's actual conditions. This important measure is to insure smooth progress of China's four modernizations. I would like to make a statement about this matter based on my own understanding.

1. The Bases for China's Energy Policy

China is one of the nations which consume large quantities of energy, occupying third place in the world only after the United States and the Soviet Union. The 1980 annual consumption of standard fuel reached 600 million tons, more than 25 times that of 1949--23.74 million tons. Energy has come to play a more and more important role in the national economy and is having greater impact on the national economy. Unless energy can be further developed, the economy cannot grow. Since the economic readjustment was made, the 1981 energy production in particular was lower than that in 1980. This had a significant impact on the national economic growth, which in 1981 was only 3 percent. The energy required to maintain the 3 percent growth rate came mainly from the energy conserved by various energy consuming departments as a result of industrial and product structure readjustment.

Experience has proven that if we want to improve the energy industry, the government must not only insure an adequate supply of capital and material, but also formulate an adequate energy policy according to China's actual conditions. What are China's actual conditions today?

1) Abundant Energy Resources

China has abundant energy resources. Its proven coal reserves are third in the world. Its water energy resources are especially rich--first in the world.

In addition to the proven oil reserves, the prospect of discovering further oil reserves on land and in the sea is bright.

Other new energy sources such as solar energy, bioenergy, tidal energy, and geothermal energy are also quite abundant.

2) Energy Industry With a Good Foundation

The energy industry has made significant progress as a result of construction undertaken over the past 3 decades. The coal and oil output over the past 3 years has maintained a steady yield of more than 600 million tons and 100 million tons, respectively. Hydroelectric power generation has been increasing year after year. The total 1980 energy production amounted to 637 million tons of standard fuel. The 1980 coal production, which was 19 times that of 1949, was third in the world. During the same period of time, electric power generation increased 70 times. Here, the increase in hydroelectric power generation was 81 times. China's total installed electric power generator capacity has reached 65.87 million kilowatts (including 20.32 million kilowatts of hydroelectric power). Large- and medium-scale hydroelectric and thermoelectric power plants are increasing in number. The increase in oil production over the same period of time was more than 800 times.

Today, there are more than 10 oil production bases and the oil refining industry has also made corresponding progress.

3) Large Potential for Energy Conservation

In the past 2 years, some definite results have already been achieved thanks to our energy conservation efforts which are beginning to take hold. Nationally, the decrease in energy consumption--or energy conservation--was equivalent to 23 million tons of standard fuel in 1979, more than 25 million tons in 1980, and it is expected to exceed 20 million tons in 1981. However, there exists great potential for energy conservation in China in view of the actual way in which energy is consumed in China. Compared with other nations of the world, China consumes a large quantity of energy with larger waste and smaller social wealth created as a result.

For example, let us compare China's standard fuel consumption per unit of gross national product with those of the foreign countries. In 1980, China's total energy consumption was 600 million tons of standard fuel while the total national product was U.S. $285.5 billion, so on average 211,100 tons of standard fuel were consumed per every $100 million worth of national product. In 1979, the corresponding figure was 43,500 tons for Japan, 48,600 tons for West Germany, 73,100 tons for Great Britain, and 106,500 tons for the United States. By comparison, China's energy consumption per unit of gross national product was 4.8 times that of Japan, 4.3 times that of West Germany, 2.8 times that of Great Britain, and twice that of the United States.

Sufficient attention is paid to effective use of energy in foreign countries. According to the data gathered by the concerned organization, the energy

utilization rate in the past 2 years has reached 57 percent or so in Japan, 51 percent or so in the United States, and 40 percent or so in the major European countries. It was only 30 percent in China. A large quantity of energy was thus wasted.

2. Development of Energy Is a Long-range Strategic Measure

Short- and medium-range development of energy must be aimed at energy conservation: Development of coal and hydropower must be emphasized above all and, at the same time, exploration and development of oil and gas ought to be accelerated. Preparation for the construction of nuclear power generation ought to be started and activities related to scientific research, experiment, and information gathering must be strengthened. The purpose of the latter is to solve the long-range energy need problem. Energy construction work usually requires a very long period of time. Basic construction of coal mines, hydroelectric power stations, and oil fields, including the preliminary engineering work, usually requires 7-10 years, and even longer in case of some extra large-scale project. Therefore, in order to be able to meet the ever-increasing demand made by the developing national economy, we must carry out as soon as possible planned construction. Otherwise, we may miss the opportunity and thus hinder the smooth growth of our national economy.

1) Development of Energy Must Take Advantage of the Dominant Feature; Do What the Local Circumstances Dictate; Develop Coal Where There Is Coal and Develop Water Where There Is Water

Energy resources are distributed widely. Coal resources are rich in the north and poor in the south. Hydropower resources are rich in the southwest, northwest, and central south and poor in other areas. From their distribution, one can see that these two energy resources complement one another. For example, Shanxi, Nei Monggol, and Shaanxi in the north are rich in coal resources. Through comparison and selection, Shanxi has been chosen as the priority construction site. Shanxi was chosen because its coal reserves, exploitability, geographic location, and communications and transportation are superior than the other provinces. In the Jiangnan area where coal resources are scarce (of course we must still do our best to develop them) more emphasis on the development of hydropower is in order. Hydropower resources are relatively rich in the southern provinces. Guangxi, Hunan, Fujian, and Zhejiang each has a considerable amount of hydropower resources. Through comparison and selection, the Hongshui River has been chosen as the priority site for continuous development of hydropower in steps along those sections of the river where the hydropower resources are rich and the conditions for construction are favorable. Needless to say, there are many other sections of rivers where hydroelectric power bases can be constructed, including the upper reaches of the Huanghe, Changjiang, and Jinsajiang.

China is in possession of many energy resources with favorable conditions conducive to large-scale development. It can be completely self-sufficient on energy. However, it is also quite important to produce more than what the nation can consume as far as possible and export the excess in order to satisfy the need for foreign trade. It appears that the time is ripe for establishing a long-range, steady energy export policy.

2) Development of Energy Must Emphasize Construction of Coal and Hydropower First

While hydropower is clean, cheap, and renewable, coal is China's main energy resource. These two energy resources must be developed preferentially. Last year, China's total primary energy production amounted to 637 million tons of standard fuel, which consisted of coal 69.5 percent, crude oil 23.7 percent, hydroelectric power 3.8 percent, and natural gas 3 percent. Coal is expected to remain China's main energy source for a long time to come, and its share will be kept at 70 percent or so.

Hydroelectric power must be exploited as much as possible. It is expected that the share of hydroelectric power and a small amount of nuclear electric power will be increased from 3.89 percent today to more than 7 percent in the next 20 years. The share is thus nearly doubled and approaches that of combined hydroelectric and nuclear electric power with respect to the primary energy of the world today.

Oil is an important strategic commodity, and more oil will continue to be discovered in the sea as well as on land. However, its main use ought to remain as raw material. Of course, a portion of it may still be used as fuel where it is absolutely necessary, or exported in exchange for an expanded trade. We should not, as we do today, burn away the greater part of oil as fuel.

Those coal mines and power stations being built today are relatively small in scale, so are unable to meet the needs for long-range development. We must increase the scale of construction to a level comparable with the rate of national economic growth. This means, according to estimates, that we must, through 3-4 years' effort, increase coal construction to 130 million tons or so and hydroelectric construction to 15 million kilowatts or so. This can be accomplished with the manpower, material power, and financial power we have today.

3) Development of Energy Ought To Be Carried Out Around Old Energy Bases Where Conditions are Favorable

Construction of some new energy bases is necessary as the national economy keeps growing continuously. The number of extra large-scale construction projects among the new bases must be kept to a minimum. A great care must be taken to examine these projects before approving them.

The energy industry already has an established foundation and the new energy bases are small in number. In making arrangements for the future development of energy, we must consider them according to the following order: First, use old bases and old enterprises and plan around these. Second, expand construction of new bases which have already been developed. Third, select and prepare appropriate sites for the development of new bases. However, we must emphasize rational arrangement so as to be able to fully develop the economic effect of the energy bases.

Experience has proven that selecting sites in the vicinity of an old base is a quick and economical way of developing and constructing energy. It can take advantage of the manpower, the facilities, and the technology that are available near an old base, and the problems related to water, electricity, and roads are easier to solve. For example, the greater majority of those established large-scale mines of the coal industry today grew up gradually from small to large in an old mine area. They get quick results with little investment.

Datong mine produced 470,000 tons of coal in 1950. With only 1.01 billion yuan of investment made by the government over the past 3 decades, it was able to increase its annual coal production to the level of 25 million tons and became the nation's largest coal mine because the base was expanded gradually using the resources of an old mine.

Kaiyi mine produced 4.39 million tons of coal in 1950. With only 1.19 billion yuan of investment made by the government over the past 3 decades, it was able to increase its annual coal production to 20 million tons and became the nation's second largest mine.

Pingdingshan is a new mine started in 1955. After more than 20 years' construction and an investment of 1.11 billion yuan, its annual production is 15 million tons. This is the proof attesting to the fact that if a new mine is constructed in the vicinity of an old one, quick and large returns can be achieved with little investment.

4) Development of Energy Should Implement the Policy of Developing Large-, Medium-, and Small-scale Bases simultaneously.

The proportion of large-, medium-, and small-scale projects has an important bearing on the growth rate of energy production. Especially in China today where there is shortage of energy supply, implementation of this policy becomes even more important. Generally speaking, a large-scale project, after it is put into operation, will produce more at higher efficiency for a longer period of time, but it requires a larger investment and a longer construction period. Medium- and small-scale projects are smaller in capacity with relatively lower efficiency, but they require less investment and shorter construction period. If development of energy involves a large number of large-scale projects, then a large portion of the limited capital will be frozen for a long period of time, and the urgent energy shortage problem cannot be solved quickly.

The large-scale project to medium-small-scale project ratio for the three areas of energy--coal, electricity, and oil--should be different one from another.

These figures are in general determined by the following factors: the situations of those projects currently under construction; the short-range and long-range growth rates of various parts of national economy; and the possibility of outfitting national economic technology. In regard to the scale of coal mines, the coal construction plan for the "first 5 year" period adopted the guideline emphasizing medium- and small-scale mines. During that period,

the average mine size was 390,000 tons. Based on the mine size of that period, large-scale mines occupied 51.5 percent; medium-scale, 33.7 percent; and small-scale, 14.8 percent. Because this distribution was basically adequate, the coal industry plan was completed one-half year ahead of schedule and thus insured sound national economic growth.

The problem we face today is the fact that there is a larger proportion of large-scale coal mines. Those new coal mines under construction in 1981 (calculation based on mine size), extra large-scale mines with design annual capacity of 3-4 million tons occupied 49.9 percent; large-scale mines with more than 900,000 ton capacity, 40.9 percent; medium-scale mines with capacity in the range of 300,000-600,000 tons, 8 percent; and small-scale mines, 1.2 percent. The average mine capacity was 1.36 million tons.

In view of the changes in various factors that may take place in the future, and taking into consideration the actual situations experienced during implementation of a number of past 5-year plans, it appears that large- and extra large-scale mines should occupy about 65 percent and medium- and small-scale mines, about 35 percent. Of course, these figures refer to the nationwide distribution. Including a portion of medium and small-scale mines that will be constructed in 1982 into estimation, the average mine capacity may be adjusted from 1.36 million tons today to approximately 1.05 million tons. It is more desirable to maintain the average mine size to 1 million tons or less.

3. Energy Conservation is an Important Measure Which Can Promote National Economic Growth and Technological Transformation

Energy conservation is an important part of China's energy policy. It also constitutes concrete implementation of the socialist conservation principle. Energy conservation, if it is done well, cannot only alleviate the energy shortage situation today but also promote technological transformation, equipment renewal and replacement, reform irrational industrial structures and product structures, raise energy management standards, improve economic work and propel the entire national economy with all its departments forward.

1) Implement Technological Transformation Centered Around Energy Conservation

The technology and equipment employed by some enterprises in China are quite obsolete. A large number of old equipments are those of 1940-50's, or even those of 1920-30's. In recent years, although we began to pay attention to the work related to renewal and remodeling of main energy consumption equipment, many old models are still being manufactured. For example, among the 28,000 different equipments manufactured by the machinery industry nationwide, one-half belongs to the old model. Moreover, there are 180,000 industrial boilers nationwide today, and the majority belong to old model equipment with an average thermal efficiency of less than 50 percent, while in some advanced nations an industrial boiler thermal efficiency in excess of 80 percent has been reached. We must replace those low thermal efficiency boilers as soon as possible. Today, nationwide, industrial boilers burn nearly 200 million tons of coal a year. If the thermal efficiency can be raised 5 percent, then 10 million tons of coal can be conserved annually.

2) Substitute Coal for Oil; Reduce Oil Burning; Plug the Oil Burning Hole

Nationwide, oil that was burned as fuel in 1980 amounted to approximately 34 percent of the total crude oil production. Electric power system was the largest consumer of fuel oil; approximately one-half of the total fuel oil consumed nationwide. Industrial boilers and kilns come next; approximately one-third of the total fuel oil consumed nationwide. Therefore, if we want to plug the huge drain of oil burning, we must put emphasis on fuel oil conservation in the electric power industry and industrial boilers. The fuel oil thus conserved may be exported and the capital thus exchanged can be used as the energy development special fund. This special fund can then be used for coal development, electric power construction, and railway and harbor transformation. Only after energy, communications, and transportation are improved can the entire national economy be propelled forward.

3) Implementing the Readjustment of Economic Structure and Product Structure

Rationalization of economic structure and product structure constitutes an important link of the energy conservation effort. In recent years, we have readjusted the proportion between light and heavy industries. The share of light industry was increased and the emphasis was placed on the development of labor intensive type products with large added value and little energy consumption. The economic structure was readjusted from energy consumption type to energy conservation type. For example, the 1971 light industry product amounted to 43.7 percent of the total industrial product. After the readjustment of the economic structure, the 1980 light industry share was raised to 47.1 percent; and in 1981, this share is expected to be raised to about 51 percent. Light industry's share was thus suddenly raised 7.3 percent within 2 years. Whenever the share of light industry product in the total industrial product is raised by 1 percent, 4.6 million tons of standard fuel can be conserved annually. The energy conserved by this item alone is quite significant.

Readjustment of the product structure is also quite beneficial to the industry in moving toward energy conservation. For example, the iron to steel ratio in China's metallurgical industry is 1.07 : 1. This ratio is 0.7 : 1 in foreign countries. In steel production, iron smelting consumes approximately 70 percent of all energy consumed in making steel. Based on China's production level today, a reduction of 0.1 in the iron to steel ratio means a reduction in 6-7 million tons of standard fuel consumed.

It is quite evident from this that it is both necessary and practical to place a priority on energy conservation as a short-range measure.

4) Implementing Scientific Management of Energy; Strengthening Basic Work of Energy Management

If we want to reap the effect of energy conservation as soon as possible, we must begin by strengthening scientific management of energy, and try very hard to strengthen the basic work of energy management. We must establish and strengthen energy management organizations at every level, perfect various

basic systems, formulate average and advanced norms, maintain the original record concerning energy utilization, carry out general surveys of energy utilization efficiency and measurement of energy balance, formulate energy conservation regulations for every unit, and train basic cadres.

In cities such as Shanghai, where key enterprises which consume a large quantity of energy are concentrated, special organizations for energy management with technical personnel assigned to them to carry out energy management should be established. The Shanghai City Fuel Company has a special energy cadre consisting of 60 technical personnel. They work all year round at the front line of a number of large energy consuming eneterprises, constantly monitoring first-hand data concerning energy utilization of the enterprises, supervising and inspecting energy conservation work of the enterprises, and propagating timely advanced experiences of various other enterprises, domestic as well as foreign. As a result of their efforts, they are getting quite significant results.

In summary, conservation and development constitute the foundation of China's energy policy. As long as we carry out conscientiously the energy policies formulated by the Central Government, the economic effect of China's energy development and conservation efforts will become more and more outstanding and have a greater impact on China's four modernizations construction.

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METHODS OF ENERGY CONSERVATION SUGGESTED

Beijing TONGJI [STATISTICS] in Chinese No 1, 17 Feb 82 pp 10-12

[Article by Zhang Zhongji [4545 6988 1015]: "Vigorously Tap the Potential of Energy Conservation"]

[Text] The shortage of energy supply is now causing a striking contradiction in our national economic development. How should this contradiction be resolved? Can we depend on an increase of energy exploitation facilities? This problem calls for intensive investigation and study.

Our country has always attached importance to the exploitation of energy resources, and the proportion of our investment in the energy industry to our total investment in capital construction increased from 13 percent during the first 5-year plan to 21.7 percent during the fifth 5-year plan. Further increase in investment in this industry will mean a corresponding reduction in the funds required for other purposes. In any case, energy projects require long construction periods and cannot meet our immediate needs. In the production of our energy industry, the total amount of primary energy resources increased at an average progressive rate of 9.6 percent each year from 1953 to 1980. Such a rate of increase cannot be considered low. In recent years, the production of petroleum for a while failed to make much headway because of the limited reserves. There is good potential for increased coal output in the Northwest, in Guizhou and in the southeastern regions of Shanxi. However, the coal transportation capacity of the railway trunk lines must be increased before the coal can be transported out. This is also somewhat difficult. In the near future, therefore, the main way to solve the energy problem is to tap the potential of energy conservation to the maximum extent.

From 1953 to 1980, our national income increased at an average progressive rate of 6.1 percent each year. In the same period, the consumption of primary energy, aside from exports and stock replenishments, increased at an average progressive rate of 9.4 percent each year, which is much more than the increase in national income. Based on this comparison, it may be more correct for us to say that instead of insufficient output, serious waste has been the cause of our energy shortage. This shows the tremendous potential for energy conservation in our national economy at present.

Potential of Energy Conservation as Shown by Three Different Comparisons

We have achieved certain success in energy conservation in the past 2 or 3 years, and there is still a very large potential left.

First, let us compare the advanced units with other units in the same fields. Among the enterprises in which the equipment and conditions of technology are generally the same, there is a great difference in the energy consumption to produce the same type of product. For example, in the comprehensive coke ratio for iron smelting among the key enterprises, the Shoudu Iron and Steel Company's consumption was 518 kilograms, while that of some others was as high as 708 kilograms, a 37-percent difference. Among the high-tension thermopower plants, the Beijing Thermopower Plant consumed 293 grams of standard coal for every kWh of electricity produced, while some others consumed as much as 445 grams, a 52-percent difference. Among the medium-size nitrogenous fertilizer plants, the Sanming Chemical Industrial Plant in Fujian consumed 1,194 kilograms of coal for every ton of synthetic ammonia produced, while some others consumed as much as 1,834 kilograms, a 54-percent difference. The Fushun No 1 Petroleum Refinery consumed 12.5 kilograms of fuel in processing every ton of crude oil, while some others consumed as much as 70.8 kilograms, a difference of 4 times. Thus if all 234 key enterprises in these four industries--iron-smelting, thermopower, synthetic ammonia and oil refining--can only maintain their consumption at the average rate of their own trades, then, according to our calculations, 4.7 million tons of energy can be saved each year.

Second, let us compare the present level with the best level ever attained. In the first 9 months of 1981, among the 54 main energy consumption indexes in the key enterprises, 30 of them were higher than those of the same period in the previous year. Among the 40 items which are comparable with the best level ever attained, 22 of them failed to reach it. The consumption of crude oil by the oilfields themselves, the consumption of electricity for silicon iron and calcium carbide, and the loss of electricity over the transmission lines were among the best level previously attained by 8-68 percent. If all 22 indexes can be raised to the best level in history, then these key enterprises will be able to save 4 million tons of energy each year.

Third, let us compare our standards with foreign standards. In our country, the overall energy consumption for each ton of steel is 2.04 tons, approximately double that of advanced foreign standards. For each kWh of electricity, we consume 443 grams of standard coal, approximately one-third more than that of advanced foreign standards. For each ton of synthetic ammonia, we consume 2.7 tons of energy, more than double that of advanced foreign standards. If only these three indexes of energy consumption can be raised to the advanced foreign standards, then each year we can save approximately 80 million tons of energy, or 13 percent of our total national energy consumption.

Of course, this is only a rough calculation of our possible savings in the three comparisons. Because of the different conditions in every country and every enterprise, there are many objective factors which make a comparison

impossible. In view of such huge differences, however, it is obvious that there is a serious energy waste in our country.

Potential for Energy Conservation from the Macroeconomic Point of View

We have saved a great deal of energy by readjusting the structures of the light and heavy industries in the past 2 or 3 years. However, the poor utilization rate resulting from the irrational industrial makeup, the product mix and the organizational structure still has not been basically changed, as shown by the following:

1. The reduction of our national income per unit of energy. During the fifth 5-year plan, the average national income yielded by each ton of energy was 529 yuan, a 55-percent reduction below that of the first 5-year plan, which was 1,167 yuan. Compared with foreign countries, we were not only far below the levels of Japan, the United States, West Germany and the other industrially developed countries, but also generally below those of the developing countries.

2. Competition between large and small plants for energy resources, For example, coke consumption for each ton of pig iron by the key enterprises is 580 kilograms, but that of small enterprises is more than 800 kilograms. In the course of readjustment, some key enterprises have been operating under capacity, while many small enterprises have been carrying on business as usual. For the production of each ton of synthetic ammonia, the large enterprises consume 1,400 kilograms of standard coal; the medium-size enterprises consume 2,500 kilograms; and the small enterprises consume approximately 3,100 kilograms. Thus the consumption by small enterprises is more than double that of large enterprises. In the oil-refining industry, the total recovery rate of gasoline, diesel oil, petroleum and lubricants in the small oil refineries is only 20-25 percent, or approximately half the national average of 46.7 percent. Because of the shortage of crude oil, some large refineries are now operating under capacity, while the small ones are producing more than 3 million tons of crude oil each year. As for the indigenous refineries run by communes and production brigades, the waste of resources is even more serious since their products are almost all substandard. Similar instances are only too numerous. Thus the precious energy resources fail to produce the maximum results.

3. Waste of energy because of the "congenital disease" left by the construction projects rashly started in the past. In the steel industry, for example, a number of iron and steel plants have been rapidly developed since the "mass steel-smelting" movement in 1958. Because of the lack of coordination, many of these enterprises have not had complete sets of equipment for iron smelting, steel smelting or steel rolling, and have been compelled to resort to the method of "transferring out iron to be smelted into steel" and "transferring out semifinished products to be made into rolled steel." Thus each year, approximately 6 million tons of pig iron have been transported to Shanghai, Tianjin, Tangshan, Qingdao and Lanzhou over an average distance of 800 kilometeres. Compared with molten iron, the use of transferred iron for steel smelting consumes 270 additional kilograms of energy, or an increase of 40 yuan in expenses for each ton. On this item alone, the country consumes

an additional amount of 1.5 million tons of energy and incurs an additional expenditure of more than 200 million yuan each year, besides adding to the strain on the transportation facilities. Another example can be cited from the experiences of a certain city with overlapping construction and excessive facilities for making oxygen and nitrogen. Each unit goes its own way in production so that the oxygen-making plant simply lets its nitrogen dissipate in the air and the nitrogen-making plant handles its oxygen in the same way. The consumption of electricity by the oxygen-making and liquid mitrogen-making equipment in the city each year is 380 million kWh, of which some 100 million kWh are wasted.

Methods of Energy Conservation

To change the situation of low energy utilization, the following tasks should be carefully attended to in the next few years:

1. In readjusting the industrial makeup and the product mix, continued efforts should be made to conserve energy. The energy consumption per unit of industrial output value in heavy industry is three times that in light industry. Through readjustment of the industrial makeup and the product mix in the past 2 years, we have saved more than 20 million tons of energy each year. The sixth 5-year plan calls for a more rapid growth in light industry than in heavy industry. Therefore, in the course of readjusting the makeup of light industry, we can still save a great deal of energy if we can use our energy conservation through readjustment of the product mix. For example, we are using huge amounts of pig iron for steel smelting, and the ratio between steel and iron output is 1:1.04. In the United States, it is 1:0.64; and in Japan and West Germany, approximately 1:0.7. If we can make better use of our scrap steel and reduce the steel-iron ratio, a huge quantity of energy can be saved. In our production of chemical fertilizers at present, the output of nitrogenous fertilizer is more than that of phosphate and potash fertilizers. This is not only a waste of energy but also a reduction of fertilizing effects. More than 800 kilograms of standard coal are required for the production of each ton of nitrogenous fertilizer; for each ton of calcium-magnesium-phosphate fertilizer, only 290 kilograms will suffice. If we can change the present ratio between nitrogenous and phosphate fertilizers from the present 1:0.2 to 1:0.5, then we can save millions of tons of energy each year.

2. We should resolutely close, suspend, merge or retool the enterprises with high energy consumption and producing unwanted goods. For some time to come, we cannot expect to have sufficient energy resources to meet the needs of the hundreds of thousands of enterprises throughout the country, and the only way out is to limit the supply to the deserving units and to eliminate those enterprises that consume a great deal of energy but produce poor results. The energy thus saved can be used to keep the other enterprises, which consume less energy but produce fine-quality goods, running at full speed. Only thus can we improve the economic results and hold the initiative in the overall situation. For example, a small or medium-size steel plant can produce some 5 million tons of steel each year, and the overall energy consumption for each ton is 1.8 times more than that of a key steel plant.

If we can reduce the output of all the small and medium-size steel plants by one-third and let the key steel plants make up their reduction, we can save more than 6.4 million tons of energy each year. Again, the annual output of our indigenous coke is more than 8 million tons, with low sintering rate and quality; there is no way to recover the gas, coking oil and other byproducts to be reused. Furthermore, the toxic matter emitted can cause cancer and is a health hazard. If we use the surplus productive capacity of large coke ovens to produce machine-made coke instead of indigenous coke, then we can save nearly 3 million tons of coal each year. Therefore, abandoning the backward in order to protect the advanced is the most practical way of energy conservation, as well as an important measure to accomplish a rational organizational structure for the enterprises.

3. We should start the work of technical transformation and equipment renovation with energy conservation as the core. At present, our economic development is about to be restricted by a slow decline in energy production. At the same time, heavy industry does not have sufficient production tasks, and the equipment and technology of the old plants are very backward. To change this situation, we should carry out technical transformation and equipment renovation for the purpose of energy conservation. The technology and many sets of equipment used for energy consumption are left over from the 1940's or 1950's, and many of them are "coal tigers," "oil tigers" and "electricity tigers." Half of the industrial boilers are old, in run-down condition, with high energy consumption, and an average heating efficiency of only 30 percent--only half that of Japan. The energy consumption of various industrial kilns is more than double that of the advanced foreign levels. Of the thermopower generating assemblies, only 10 percent are high-pressure heating assemblies, and most of the rest are of the condenser type, from which approximately 60 percent of the heat is carried away by the water cooling system. There are in the country 500,000 old motor vehicles with appalling gas consumption. Here is a great potential to be tapped. The substitution of high-pressure heating assemblies for those of high energy consumption alone will help us save 13 million tons of energy each year. Again, for example, a certain oilfield now has 200 sets of old water-injection pumps. If they are replaced by pumps of a new model, each year we can save 360 million kWh of electricity or 18 million yuan, although the replacement of these pumps costs 13 million yuan. It is true that equipment renovation and technical transformation will cost money. Compared with investment in the exploitation of energy resources, however, the economic results are far better. First, it costs less and yields quicker results; second, it conserves energy and lowers the production costs; third, technical transformation usually brings about benefits in many respects, such as savings in water, reduction of environmental pollution, and so forth; and fourth, it makes new technological demands on the machinery trade, prompts the upgrading of mechanical and electrical products, and helps keep the machinery trade busy. The whole heavy industry will be revitalized.

4. We should vigorously promote the comprehensive utilization of energy by adopting new technology and new work processes. Because of our backward industrial technology, a great deal of energy which could have been comprehensively utilized has been simply wasted. According to our calculations, the gas emitted by blast furnaces and kilns and allowed to dissipate each year is equivalent to 1.3 million tons of standard coal. If it can be recovered and utilized, we can not only conserve our energy, but also prevent

environmental pollution. In the oil-refining industry, we can raise the processing level of crude oil so that many components which can be used as industrial chemicals can be cracked or separated for rational utilization; the value of the same amount of oil will then be increased several-fold. If the 12 sets of catalytic reforming equipment, most of which are of backward technology in use since the 1940's, are replaced by new ones, we can increase our output by more than 400,000 tons of aromatic hydrocarbon, and, with the addition of other raw materials, we can produce more than 500,000 tons of chemical fibers with an output value of $700-900 million based on the international market price. The cost of technical transformation for these 12 sets of equipment is not more than 50 million yuan in renminbi. Actually, this type of technical transformation is by no means difficult. The three oil refineries in Fushun, for example, produce some 260,000 tons of tail gas which is mostly burned up or discarded. If we make comprehensive utilization of it, we need to invest only 200 million yuan, and can produce various types of chemical industrial products worth more than 400 million yuan, including some 200 million yuan of profit. The investment can be totally recovered in the same year. In this way, we will not only promote the development of the petrochemical industry but also increase state revenues and the supply of daily consumer goods on the market.

In conducting comprehensive utilization, we should at the same time promptly make use of the fruits of scientific research on production, and the energy conservation measures which have proved to be effective--such as the use of marsh gas and far infra-red equipment for drying, the utilization of solar energy, and the blowing of coal dust into blast furnaces--should be energetically popularized.

5. We should strengthen the management of energy and prevent waste. At present, the enterprises in many localities are not strict enough in energy conservation, while the setting of consumption quotas has been reduced to a mere formality. In 1981, for example, a total of 239 indexes were listed for energy consumption in a certain province, yet only 94 of them were included in the plans handed down to lower levels by the departments in charge. Among these planned indexes, only 84 to 89 percent of them were higher than those of the previous year, thus nullifying the guiding role of these plans. In some enterprises, the quantity of incoming energy resources is not checked, and there is no set limit for consumption. The practice of "eating from the same pot" is still prevalent. In other plants, no special personnel are assigned to take charge of energy resources, so that the workers and their dependents can help themselves to the plants' coal or coke for cooking of heating purposes. This situation must be corrected. We must strictly practice the system of energy ration coupons and supply energy only to the deserving units. The enterprises should also strengthen their energy management, set in order and improve their firsthand records, statistics, calculations and inspection methods, energy consumption quotas and other basic tasks, one by one. At the same time, political and ideological education should be stepped up among the workers and staff members, and energy conservation should be treated as the main aspect of economic responsibility. Constant checking should be also conducted in order to remind everyone of the need for energy conservation.

Furthermore, through long-rang plans, we should gradually change the irrational pattern of production in order to reduce energy waste.

9411
CSO: 4006/347

RATIONAL UTILIZATION, CONSERVATION OF ENERGY RESOURCES URGED

Beijing ZHONGGUO CAIMAO BAO in Chinese 9 Feb 82 p 3

[Article by Wang Yongyin [3769 3057 6892]: "We Must Concentrate on Conserving Our Energy Resources and Increasing Their Utilization Rate"]

[Text] In his report on government work, Premier Zhao Ziyang clarified the principle for solving our nation's energy problems. We must "give attention to development and conservation and give priority to conservation from now on." This is a practical policy that starts from the reality of China's situation. Energy resources play an undeniable and decisive role in industry and in the overall national economy. Since the 1960's, the production of China's energy resources such as oil and coal has increased rapidly and has quite successfully ensured the needs of production and the necessities of life. In the past however, many oil fields and coal mines were overexploited, which led to an imbalance between extraction and reserves and between extraction and excavation. Subsidies were required to repay outstanding accounts and extraction could not be carried out on a large scale. Consequently, the production of energy resources in the next few years will not increase to any great extent. On the other hand, shortages in our energy resources have occurred because enterprises that use up vast quantities of our energy resources have expanded without appropriate planning and because their structural organization has become unwieldy. The shortages are also due to the irrational use of energy resources and alarming wastefulness. At present, the production capacity of many enterprises cannot be fully harnessed because of short supplies of coal, oil and electricity. Once many new construction projects are completed they cannot be put into operation on schedule. In addition, a large number of oil consuming machines and tools have been put away and their use suspended. Energy problems have already had a critical impact on our national economic development.

The solution to our energy problems is first development and then conservation. In terms of our long-term needs, it is necessary to accelerate the development of our energy resources. Only then can we increase the total output of our energy resources for consumption. We have abundant reserves of energy resources. Our water power resources rank first in the world at more than 670 million kilowatts. Our proved coal reserves rank third in the world at 640 billion tons. For the most part, the oil potential in dry land sedimentary rock areas and in the coastal continental shelf has not yet been thoroughly

explored. The future prospects for our national energy resources are undoubtedly excellent provided that we continue to emphasize work in this area. However, we must realize that the large-scale expansion of our energy resources and increasing the supply of our energy resources takes time. It is not possible to resolve our current energy shortages all at once. Therefore, the key to solving future energy shortages is still to rely on conservation and to increase production while conserving energy. This is the reason why we stress giving equal attention to both development and conservation and to giving top priority to conservation from now on.

The question then arises, is it possible to give top priority to conservation and to increase production while conserving energy? The answer is in the affirmative. At present, China's energy output is second to that of the United States, the USSR and Saudi Arabia. However, the GNP and the national income created by the energy consumption of certain units is substantially lower than in many other countries. China's total annual energy consumption converted into ideal fuels is roughly the same as Japan's but the realized GNP is only approximately one-fourth that of Japan's. In comparison with the period of our "First Five-Year Plan," the national income as created by the energy consumption of units at the present time only comes to one-half that of that earlier period. Although there are some factors involved that cannot be compared, this nevertheless reflects China's current high rate of energy consumption, the great wastefulness and the irrational utilization of energy. China's potential capacity for conserving energy should be greater than that of industrial developed nations. Increasing production while conserving energy can certainly be done and should be done.

Conserving our energy resources is not only a requirement for easing current energy shortages, it is also an essential requirement for getting our national economy onto a new and correct path. From now on we must start from the reality of our current situation and set out on a new path at a more realistic pace. This new direction must have better economic benefits and allow the people to obtain greater material benefits. The focus of this new path is to use every possible means to improve economic results and expend as little labor as possible to create as much social wealth as possible. Energy conservation can reduce costs in the form of value and it can lead to greater utility of material objects thus causing outstanding improvements in economic results.

At present, China's national economy is just now implementing further readjustment. We must implement in a combined way the policy of "readjustment, restructuring, reorganization and upgrading." We must stress the task of successful energy conservation in the following five areas.

First, we must continue to readjust industrial structure and product structure among firms and occupations and restructure their energy needs. Second, we must strive to readjust and reorganize the structure of enterprises so that they utilize energy resources in a rational way. Third, we must launch technical reforms that emphasize energy conservation. We must gradually eliminate obsolete equipment that uses up too much of our energy resources. Fourth, we must make every effort to reduce the depletion of raw and processed materials and raise the quality and marketability of products. Fifth, we must strengthen

the management of our energy resources, work out and improvemethods of rewards and penalties and the management system. We must ensure that the management of our energy resources gradually moves toward scientific management.

China's work in energy conservation has just begun. Our potential capacity for energy conservation is great. It is worth paying attention to the fact that, at present, work in energy conservation has not yet aroused widespread concern. We must further motivate all units that are involved with energy resources so that they fully recognize the importance and urgency of conserving our energy resources. We must develop a spirit of saving each jin of coal, each drop of oil, each kwh of electricity and each sheng of water to actively make a contribution to the conservation of our energy resources. Only if the whole nation, all trades, professions and fields take action to set off a new mass upsurge for energy conservation, only then can our work in energy conservation achieve even greater successes.

9864
CSO: 4013/16

FORMULATING STRICT ENERGY CONSUMPTION STANDARDS

Shenyang LIAONING RIBAO in Chinese 4 Jan 82 p 1

[Article: "Exert Efforts To Produce Highly Efficient Energy Conserving Machinery and Electrical Equipment"]

[Text] To solve the energy shortage problem, all professions have strengthened control over energy during the past 2 years, such as implementing strict supply plans, establishing standards for energy consumption, rewarding those who conserve energy, and stopping certain cases of waste. But as energy conservation work deepens, management alone is not enough. Technical measures must be taken. Efforts must be exerted to produce highly efficient and energy conserving machinery and electrical equipment. The rate of utilization of energy must be improved. These constitute an important measure of energy conservation.

The sectors that consume a lot of energy are metallurgy, chemical engineering and urban construction. But almost all of the energy consumed by these sectors is actually consumed by their machinery and electrical equipment. According to statistics, in the total consumption of coal, electric power and gasoline, 50 percent, 60 percent and 90 percent respectively, are consumed by machinery and electrical facilities. It can thus be seen that developing and improving highly efficient and energy conserving new machinery and electrical equipment, and eliminating out-dated old equipment are the fundamental ways to conserve energy. The machinery and electrical equipment manufactured by the machinery industry in the past are mostly old products of the 1940s and 1950s. Their energy consumption is high. Their efficiency is low. They have been called the "tiger that is hungry for coal," the "tiger that is hungry for fuel," and the "tiger that is hungry for electricity." The machinery industry released these tigers and after they came down from the mountains, the other industries and professions had to fight the tigers, thus expanding more energy and wasting a lot of money and materials. The departments and enterprises that manufacture machinery and electrical products must see their own responsibility and must not "release the tigers" again.

Over the past 2 years, because of the efforts of our province's machinery sector and the active coordination and support by various concerns, a batch of machinery and electrical equipment that can conserve energy has been manufactured. Recently, the Provincial Machinery Bureau has recommended to the whole province 50 types of energy conserving machinery and electrical products.

Among them, the DG270-140C boiler and water feeding pump developed by the Shenyang Water Pump Plant have a 6 percent higher efficiency than the old products. Each unit can conserve 1.528 million kilowatt/hours of electricity a year, equivalent to 122,240 yuan. Each unit of this equipment is priced at only 71,300 yuan. The maximum static pressure efficiency of the axial flow ventilator for mines developed by the Shenyang Blower Plant has been increased from 71 percent o 84.5 percent. Each unit can conserve 1 million kilowatt/-hours of electricity each year, equivalent to over 30,000 yuan. The 61020 model diesel engine developed by the Chaoyang Diesel Engine Plant can replace the "Liberation" gasoline engines for automobiles. The consumption of fuel per 100 tons/mile was lowered from 29 liters of gasoline to 13.3 liters of diesel fuel. These facts show that the direction of developing energy conserving machinery and electrical equipment is correct. We must combine the development and improvement of energy conserving equipment with the technological reforms of the various professions in the national economy. The machinery sector must direct its attention towards products with a wide scope, products produced in large batches, and products that consume a lot of energy to serve as the major targets for improvement and to use them to search for newer reforms. At present, the key point is to carry out the work of rebuilding equipment for medium- and small-scale power stations, for power transmission and transformer equipment, for various types of boilers, for internal combustion engines and for various types of power consuming equipment (such as ventilators, water pumps, electric motors).

The development of highly efficient energy conserving machinery and electrical equipment must take into consideration the comprehensive economic results in society. To the manufacturing units, producing energy conserving products will require a higher cost because of the investment in new raw materials, in manufacturing new tools and in increased working time. The enterprise itself may not benefit but may even suffer a loss. But the users will reap a large economic result. This requires the equipment manufacturing plant to establish a concept of the overall situation. The ordinary useful life of machinery and electrical equipment is relatively long. When manufacturing such equipment, more work and more efforts are temporarily required but better economic results can be achieved after several years of operation. This also requires the manufacturing plants to establish a long range view. We must self-consciously require the local situation to obey the overall situation, take the initiative to carry out the task of producing energy conserving equipment and exert efforts to realize comprehensive economic results for the whole society.

Development and improvement of energy conserving machinery and electrical equipment should allow the function of technical personnel to develop fully. We must care about and encourage technical personnel to concentrate all efforts in product design and development. We must provide material incentives to those advanced collectives and advanced individuals who have made outstanding contributions while strengthening ideological and political work. The factories must establish research institutes and exert efforts to develop a technical superiority. In product design, we must conscientiously summarize the experience of the producing factories and the users, and at the same time, we must actively learn and use new techniques and new technologies of our nation and foreign nations so that our energy conserving products can strive towards the most advanced levels.

9296
CSO: 4013/2

HIGH ENERGY WASTAGE HAMMERS HOME NEED TO CONSERVE

Beijing GUANGMING RIBAO in Chinese 6 Mar 82 p 3

[Article by Chen Fubao (7115 1381 0202) and Li Jie (2621 2638): "Clear the Way for Energy Conservation"]

[Text] Energy resources are the key to national prosperity and the modernization of production. Our ability in the future to maintain a relatively high rate of development of our national economy will depend to a large extent on how well we can resolve our energy problem. At present, the energy shortage looms as a problem of strategic proportions that affects our nation's economic development across the board.

How do we resolve this problem? There are two ways: 1) developing new energy sources; and 2) conservation. For intermediate and long terms, the two solutions should receive equal attention. For the short term, conservation actually should take precedence over development of new sources. There is no question that there is a lot of room for conservation in our country. Nationally, we are consuming from two to three times more energy than some other nations. Furthermore, our present energy consumption is double that of the period of the First Five-Year Plan. If we can take the necessary economic, technological and administrative steps toward conservation, we can achieve far greater social prosperity with the energy resources now available to us.

There are, of course, many ways to conserve energy. We suggest that we begin conservation in the following areas:

1. Continued Adjustment of Economic and Product Structure

For a long time, we have been hampered by an imbalance in our economic and product structure, in which heavy industry has too heavy a share and light industry too light a share. This imbalance is one of the main reasons causing the shortage. For example, to produce the same amount of national income, the heavy industry consumes three times more energy than light industry and 13 times more than agriculture. Similarly, energy consumption also varies in the production of from one product to another. For example, it takes twice as much energy to produce 1 ton of nitrogenous fertilizer than phospherous fertilizer. This makes it clear that a change in the economic and product structure can result in sizable energy savings. Thus it is necessary for us

to speed up the adjustment of our economy, to give priority to continued development of the consumer goods industry, to direct heavy industry into new outlets for its services, and to establish more labor-intensive consumer goods industries that require small investments, consume little energy, and bring fast returns. While readjusting our economy, we must simultaneously change the product structure. For example, if we can change the undesirable situation where a glut in nitrogenous fertilizer exists at present while phosphorous and potassium fertilizers are in short supply, we will not only cut down energy consumption in fertilizer production but also make our fertilizers available in a more balanced mix for the benefit of agricultural production. For another example, we have more iron than steel in our country and this imbalance accounts for the high energy consumption in our steel making industry. By estimate, if we can use more steel scrap as raw material and cut the iron production by a mere 0.1 percent in relation to steel production, we will save 7 million tons of standard coal a year.

2. Technological Renovation Toward Greater Energy Conservation

In our country, power generation, metallurgy, chemical industry, construction material production, petroleum refining, and railway transportation are considered the six energy guzzlers. Their combined energy consumption amounts to 60 percent of the nation's total. These six large energy consumers are partially hampered by old equipment and backward technology that contribute to a higher wastage than normal. We must introduce certain technological renovation into these six departments emphasizing energy efficiency. The power industry, for example, can cut down energy consumption by selectively and systematically modernizing its low and medium voltage generating units and gradually replacing them with larger and more energy-efficient units. Such an effort will result in an annual saving of 19 million tons of coal. Furthermore, if we can make use of the exhaust from power generating plants for home heating, make more efficient use of energy resources, reduce electricity consumption within the power plants themselves, and cut down line loss, we will achieve even greater energy savings. Our metallurgical department consumes twice as much energy as in any other country in producing each ton of steel. If we can gradually upgrade our steel making technology to bring down the energy consumption per ton of steel, we will save 20 million tons of standard coal a year. Small chemical fertilizer plants, small cement plants and small brickyards are energy guzzlers. We should have the courage to close down all those units showing poor energy efficiency and rechannel the energy resources thus saved into areas more vital to our national economy. The petroleum industry should strive to cut down its own energy consumption, reduce refining losses, and increase the marketable and usable rate of its petroleum products. This way it might save our nation several million tons more of standard coal a year.

3. Upgrading Some Key Products and Discontinuing Others

With the steady advance in science and technology, we must break away from the decades-old list of key products. We must replace the technologically backward, energy wasteful, and qualitatively poor products with technologically advanced, energy efficient, and high-quality goods. The trend in production in

modern times has called for such replacement. It similarly offers our country a way out of its energy problem. For example, half of the boilers in use in China are either old, or worn-out, or patchwork types. Their heating efficiency is 20 to 30 percent lower than foreign-made boilers. Because of their inefficiency, they are consuming tens of millions tons of coal more than normal every year. For this reason, we must make up our minds to discard ancient boilers, retool the inefficient boilers, upgrade the technology in boiler making, and restrict the production of low-efficiency boilers. At the same time, we must step up our research effort toward the manufacture of new types of boilers, types that have larger capacity, types that can handle higher steam pressure, and types that burn cheaper fuel. There are also other new ways of marrying boiler technology to energy conservation. Our automotive industry is another sector where huge energy savings are possible. The industry should strive for design improvements and better workmanship, improve on the old car models and develop fuel-efficient new models, improve on gasoline engines and develop diesel engines. If it can gradually catch up with the advanced auto making technology of the world, it will save our nation several million tons, even as much as 10 million tons of fuel.

4. Fast Expansion of Coal Dressing Industry To Increase the Production of Dressed Coal

For a long time, the percentage of dressed coal has hovered around 18 in China's total coal production (the percentage is 32 in China's rational coal), a low figure. Every year our country invests very little in coal dressing facilities, roughly about 2 percent of our total investment in coal mining. As some 80 percent of the coal is supplied to consumers in an undressed and unprocessed form, the wastage is horrifying. For example, the coal used to fuel railway locomotives and the coal used by chemical departments as raw material for synthetic ammonia is usually undressed coal, generating a waste of some 7 million tons of coal a year. Most of the rationed coal is not dressed either. Let us assume that such coal contains an average of 15 percent of impurities. Such impurities are hauled around the country for as much as 12.3 billion ton/kilometers in an average year. In other words, 200 railway cars and 5000 trucks are used unnecessarily to carry them. It means a waste of 100 million yuan in transportation cost. To cut down this waste, more investments in coal dressing facilities are needed. In addition, we should allow higher quality coal to fetch a higher price, thereby providing the enterprises an incentive to improve their coal dressing ability and to increase the percentage of dressed coal relative to total coal output. This way we can reduce the burden of the railway system to haul undressed coal around the country.

5. Improvement of Business Management

This offers a broad area for energy conservation. There are numerous ways for us to achieve our objective, such as improving the utility rate of various resources, reducing waste in raw materials, increasing productivity, upgrading the quality of products, reducing the rate of production line rejects, speeding up the turnover of resources, reducing the time of capital tie-up, rerouting transportation lines, improving transportation between economic and natural

zones, consolidating warehousing and transportation needs, etc. There is plenty of room for conservation in this broad area. For example, if we can raise the utility rate of steel products to 80 percent, we will save 2.5 million tons of steel products. This saving will translate into a saving of 12.5 million tons of fuel. For another example, if we can raise the utility rate of chemical fertilizers from the present 30 percent to 60 percent, we will save 20 million tons of energy resources. Our country produces a lot of low-quality products and suffers from a high rate of industrial rejects. It means our precious energy resources are going down the drain. If all our enterprises have the determination to raise the ratio of good and acceptable products, reduce the ratio of rejects and sub-standards, and pay attention to shipping and storage as a means of preventing damage to their products, they will greatly cut their energy needs.

6. Conservation of Energy for Home Use

The average home consumption of energy is low in our country. In fact, an acute energy shortage is felt by the rural population. Some 70 million rural homes are not even getting enough fuel for cooking. This is one side of the problem. The other side of the coin is a high waste rate of energy for home use. For example, the utility rate of coal for home heating is only 15 to 20 percent. This translates into a waste of 20 million tons of coal a year. With the development in production and the improvement of living standards, we expect the energy needs for the home to increase rapidly. We must study the present level of energy resources available and the potentials for developing new resources as well as the changes in the life styles of the nation to decide how best to conserve energy without affecting the improvement in the living standards.

We are a populous nation. If every individual is committed to eliminating energy waste and promoting energy conservation, the problem of energy shortage in our country will be readily solved.

9055
CSO: 4013/33

CONSERVATION ESSENTIAL TO CLOSE GAPS IN ENERGY RESOURCES

Nanjing XINHUA RIBAO in Chinese 12 Feb 82 p 1

[Article by Staff Reporter Cai Mingde: "Responsible Person of the Provincial Economic Commission Reported at Meeting of Energy Conservation Consultative Committee That Conservation Is Needed To Remedy Large Gaps in Energy Resources"]

[Text] Gaps in our province's supply of energy resources are larger than last year. However, the potential for conservation is also large. The vigorous development of our conservation potential is an important way to remedy the gaps in energy resources. This was the view expressed by Vice Chairman Wang Guixiang of the Provincial Economic Commission during the first meeting of the Provincial Energy Conservation Consultative Committee called by the Provincial People's Government on 6 [February].

According to Comrade Wang Guixiang, notable results have been achieved in energy conservation in our province in the last 2 years. The unit energy consumption of many enterprise products has decreased year by year. In 1980 consumption in terms of standard coal for every 100 million yuan of industrial production value was 42,700 tons, down from 47,900 tons in 1979. It was down to 38,400 tons in 1981. Savings in terms of standard coal were 2,200,000 tons and over 2,320,000 tons in 1980 and 1981 respectively. These savings had an important impact in guaranteeing the increases in industrial output in our province in both years. An increase in industrial output of 5 to 6 percent is called for this year. Computed on a 5-percent increase basis, an increase of 1,320,000 tons of raw coal is needed. However, based on the planned production of raw coal in the province and the state's allocation of raw coal, heavy oil, and petroleum products converted to the equivalent of raw coal, the estimated gap will be 22.73 percent of the total energy consumption. This compares to only 22 percent last year.

However, the potential for energy conservation in our province is still very large. Energy conservation work in the last 2 years concentrated mainly on management, promotion of new techniques, and readjustment of product mix. Technological reconstruction that can produce better results in energy conservation has just been started. If we vigorously stress this new work based on our own funding, technology, and other conditions, if we gradually change the technological backwardness of our energy-consuming facilities, and

at the same time if we continue to stress the management of our energy supply and use, and the readjustment of our product mix limiting or stopping the production of high energy consumption and not urgently needed products, we will be able to take a big step forward in our energy consumption work and ease the contradiction of imbalance in our energy supply and demand. The key of reaching this goal is to raise the energy conservation awareness of the cadres and masses on the industry and communications battle lines and concentrate on energy conservation as a strategic problem.

During the first meeting of the Provincial Energy Conservation Consultative Committee, Deputy Manager Sheng Yuenian of the Provincial Fuel Materials Company said that energy resources have an important relationship to the development of natioal economy and safeguard the people's livelihood. However, currently there are still an important number of comrades in leading organizations and plants and enterprises who are not paying enough attention to this. In some of the leading organizations and plants and enterprises in the light and textile industries, special energy conservation organizations have not been established and no special persons are responsible for energy conservation work. If this situation is not changed, it will not be possible to properly carry out energy conservation work.

Specialists attending this meeting suggested: In order to raise the energy conservation awareness of the cadres and masses, the government should adopt some essential economic measures in addition to continue to strengthen public education. For instance, a system of selective supply to enterprises should be implemented. Where energy consumption is excessive, consideration should be given to reducing supplies, limiting supplies, increasing prices, or even stopping supplies depending on the circumstances. And rewards and punitive measures should be implemented for the cadres leading and directing the use of energy resources in the plants and enterprises. Conservation should be rewarded. Waste should be punished. These measures should be widely and thoroughly implemented.

5974
CSO: 4013/17

NEW VENTILATION SYSTEMS SAVE 1 MILLION KW/HR PER YEAR

Shenyang LIAONING RIBAO in Chinese 4 Jan 82 p 1

[Article by reporter Xie Huaiji [6200 2037 1015]: "Shenyang Blower Plant Produces a New Type of Ventilator According to User's Needs; One Unit Conserves an Average of 1 Million Kilowatt/hours Per Year"]

[Text] A new ventilator has been successfully produced by the Shenyang Blower Plant recently. Its conservation is outstanding. One unit can conserve an average of 1 million kilowatt-hours of electricity a year. The cost of electricity conserved over two years is sufficient to purchase this ventilator which costs 60,000 yuan. If the 2,500 old fashioned ventilators throughout the nation at present are all replaced by this new ventilator, 1 billion kilowatt/hours of electricity can be conserved a year, equivalent to the amount of electricity generated by a medium sized power plant in 1 year.

This ventilator is mainly used in coal mines. Its function is to draw away gas in the mine shafts and pump fresh air into them. The greatest shortcoming of old fashioned ventilators produced by the Shenyang Blower Plant in the past is that they have a low efficiency and they consume a lot of energy. The users call them "electricity tigers." Many users have organized "tiger beating teams" to conserve electricity. They rebuilt the old fashioned ventilators but because the design was irrational, minor reforms did not help. The hard facts educated the workers of the Shenyang Blower Plant: The "tigers" must not be allowed to be produced anymore and bring harm to the users! They know that nearly one-half of the amount of electric power generated throughout the nation is consumed by various types of electrical machinery, and one half of the electricity consumed by electrical machinery is consumed by ventilators, blowers, compressors and water pumps. The first three products have been produced by this plant. It seems, developing energy conserving products has become an urgent task at present. After half of year of study and experiment, the 2K60 model axial flow ventilator for mines was born. Evaluation showed it reached the advanced international standards of the 1970s, and its efficiency is 15 percent higher than that of the previously produced ventilators with a technical standard of the 1940s. The new product was welcomed by users as soon as it was marketed.

This reporter visited the Shenyang Blower Plant on the eve of the New Year. Deputy manager of the plant, Liu Xuan [0491 3763] talked about the test

production of the ventilator and views on readjusting the national economy. He made a fist with his right hand and then held it against his chest. Then he struck out. He said, we are now engaged in readjustment. The purpose is to give more strength to the punch. Our departments of heavy industry must find new ways to readjust service and improve technical standards. We must never rely solely on selling ice cream, cold drinks and fruit, and on opening restaurants for a living!

9296
CSO: 4013/2

ENERGY CONSERVATION IN THE PRODUCTION OF SYNTHETIC FIBERS

Shanghai FANGZHI XUEBAO [JOURNAL OF TEXTILE RESEARCH] in Chinese, No 6, 1981, pp 67-69

[Article by Sun Shoukang [1327 1108 1660] of the Shanghai General Petrochemical Plant: "On the Question of Energy Conservation in Synthetic Fiber Production"]

[Text] Developing the production of synthetic fibers is a major task in solving the problem of clothing of our nation's 100 million population. At a time when there is a shortage in petroleum resources, rationally utilizing presently available resources and energy has become a problem that urgently requires policy discussions.

I. Synthetic Fiber Production Must Emphasize Energy Conservation

Synthetic fiber production is a productive sector that consumes a lot of energy. But because of the high profits from synthetic fibers in the past, the problem of energy has never attracted attention. Starting from the middle of the 1970s, the energy crisis gradually deepened, and the synthetic fiber production sector that had always emphasized quality and neglected energy consumption also began emphasizing the utilization of various methods of energy conservation to make up for the shortage in petroleum. For example, the average energy consumption by Japanese synthetic fiber producers in 1978 was 28.9 percent [1] lower than that in 1975. The measures of energy conservation in synthetic fiber production consisted of two aspects: First was the improvement of technology. The comprehensive energy consumption for the production of monomers was reduced in chemical reactions. The second was to utilize effective energy conserving techniques in various production links to recover energy. The measures for energy conservation in the production of major products are briefly described below:

1. Emphasis on the selection and study of techniques of monomer production

Three-fourths of the combined energy consumption to produce polyester and polyamide fibers is used in the synthesis of monomers. Therefore, the selection and study of techniques to produce monomers are especially important.

The production of dimethyl terephthalate (abbreviated DMT in the following) consumes methanol. Consumption of raw materials is also large. The Toray

method uses cold water cooling to eliminate reaction heat. Its combined energy consumption reaches as high as 18,100 kilocalories/kilogram. The Witten production method recovers a part of the reaction heat and reduces the comprehensive energy consumption of DMT to 15,400 kilocalories/kilogram. The Amoco method recovers more reaction heat in high temperature oxidation and also eliminates the use of methanol, and thus reduces the comprehensive energy consumption for producing terephthalic acid (abbreviated TPA in the following) to 10,800 kilocalories/kilogram. Half of the energy consumed is used in high temperature hydrogenation. The Maruzen method eliminates energy consumption for hydrogenation and reduces the comprehensive energy consumption of medium pure TPA (abbreviated MTA in the following) to 8,000 kilocalories/kilogram. This has become the production techique that consumes the least amount of energy at present [2-7]. Because direct esterification of TPA can reduce the proportion of ethylene glycol, comprehensive energy consumption of polyester is 30 percent less energy than the DMT method. Therefore, developing MTA production is the key to realizing energy conservation in polyester production. But the comprehensive energy consumption for the production of the coarse products of TPA by the Toray method has already reached 10,000 kilocalories/-kilogram. Changing to the production of MTA must also involve a lot of work to establish serial heat supply for acetic acid distillation, coarse product counterflow washing, tail gas turbines and low temperature surplus heat recovery before the comprehensive energy consumption of producing MTA by the Toray method can be greatly reduced.

Although the main technique for producing hexanolactam is short, its consumption of various raw materials reaches 6 tons, and the amount of ammonium sulfide by-product reaches as high as 4.8 tons. Therefore, its comprehensive energy consumption reaches 39,000 kilocalories/kilogram, and it is the synthetic fiber monomer that consumes the highest amount of energy. Although some improved methods have reduced the yield of ammonium sulfide by half, but the consumption of raw materials is still between 3.5 and 4.2 tons. Pyrolysis of ammonium sulfide into sulfur dioxide and nitrogen under high temperatures and then producing sulfuric acid for re-use actually waste nitrogen and also consume a large amount of heat. Corrosion of equipment is serious, and the amount of energy consumption and production costs are not reduced. In the synthesis of butane dicarboxylic acid, the non-catalytic oxidation technique [8] can be used as an example. The energy consumption for power to oxidize cyclohexane to ketols reaches as high as 6,000 kilocalories/kilogram, constituting 40 percent of the total consumption of energy for power to produce polyamide fiber-66 salt. If a third carbon atom is introduced into the molecules of cyclohexane to improve the selectivity of oxidation, the energy consumption of ketols and butane dicarboxylic acid can both be reduced by a large scale. If hexadiamine can be synthesized using butadiene instead, this will further reduce the overall energy consumption of butane dicarboxylic acid ammonolysis by 45 percent [9]. Hexadiamine can also be synthesized from acrylonitrile and the procedures are few. Therefore, in long range considerations, producing polyamide-66 fiber will benefit the study of new technologies with low energy consumption, and it will also benefit the comprehensive utilization of the C_4 fraction.

2. Strengthen the utilization of thermal energy in spinning

The energy consumed to spin acrylic fiber is 33,100 kilocalories/kilogram [10], constituting 56 percent of total energy consumption. The energy consumed in spinning polyvinyl alcohol fiber is 25,700 kilocalories/kilogram [11], constituting 67 percent of total energy consumption. Both are a lot higher than the energy consumption of polyester and polyamide fibers (Energy consumption for spinning polyester fiber constitutes only 30 percent of the total, and that for spinning polyamide fiber constitutes only 21 percent of the total). According to statistics compiled by the Shanghai General Petrochemical Plant in the production of each kilogram of acrylic fiber: Spinning consumes 14,800 kilocalories. The amount of recovery is 15,300 kilocalories. Spinning woolly strips consumes 150 kilocalories, and the energy consumed in spinning other types of fibers is 1,850 kilocalories. The distribution of energy consumption in the production of polyvinyl alcohol fibers is also similar. This shows that energy consumption levels must be considered to realize multilevel utilization of steam, and we must actively improve the concentration of solidified liquids and air conditioning for refrigeration in wet method spinning. Taking the annual production of 47,000 tons of acrylic fibers of the Shanghai General Petrochemical Plant as an example, if second evaporation can be changed to third evaporation, 15,000 tons of heavy oil can be conserved in a whole year. If the heat supply for evaporation can be changed to using a heat pump, annual conservation of heavy oil will amount to over 30,000 tons. If condensed water is recycled to the water purification station as a supplementary water supply, another 10,000 tons of heavy oil could be conserved in a whole year. If the temperature of the solidified liquid can be raised in spinning and if heat absorption pipes can be used for cooling, another 10,000 or so tons of heavy oil can be conserved in a whole year in refrigeration. If the hot water released can be used by the absorption type refrigerator to provide refrigeration for spinning, or if the hot water is recovered by an organic turbine and converted to power, then another several dozen thousand tons of heavy oil could be conserved in a whole year. Therefore, a power station for recovering low temperature surplus heat should be established. It could serve as a measure to replenish the power source and it could also eliminate heat pollution in the surrounding areas of the plant. This is a direction that should be considered in the medium and long range plans of wet method spinning.

II. Establish Technical Policies Related to Energy Conservation

1. Establish a comprehensive energy consumption examination system

Ordinary synthetic fiber production utilizes only a small portion of crude oil. The rate of utilization in the production of synthetic fibers using crude oil of different quality varies greatly. Therefore, numerical values of energy consumption should be used to include all types of production processes, and a comprehensive energy consumption examination system for products should be established so that products can be compared. After understanding the differences in energy consumption, we would be able to point out the direction to improve rational utilization of energy.

2. Prices should be rationally readjusted

Compared to foreign nations, the price of crude oil in our nation at present is low while the price for fibers is very high. This man-made profit actually hides the backward situation in our nation's petroleum and synthetic fiber production. We believe, many types of power generation cannot use enthalpy but must be based on effective energy to separately improve and establish the price of steam at different pressures and the prices of electric power and other public utilities. This will stimulate the use of low grade energy (such as low pressure steam and hot water) in production as much as possible so that such energy conserving measures as generation of electricity by differential voltage, generation of electricity by tail gas turbines, and the use of absorptive refrigeration can be actively popularized. Prices for synthetic fibers should also be established on the basis of average comprehensive energy consumption and rational business administration costs. The development of conservation work will continually lower the cost of synthetic fibers and develop rational products, expand the domestic market and establish a foundation for pricing synthetic fibers for export.

3. Develop joint production and cooperation between plants

Each set of refinery facility with a refining capacity of 2.5 million tons a year can produce 40,000 tons of p-xylene after rectifying the gasoline fraction. Our nation's oil refineries frequently mix these aromatic hydrocarbons into gasoline as fuel and burn them. After coordinated adjustment, if these aromatic hydrocarbon resources can be provided to synthetic fiber plants as raw material, the present lengthy process of the petroleum refining and synthetic fiber producing plants and the shortage of crude oil can be greatly improved. On the other hand, isomerization is also a technological process that consumes a lot of energy. The energy consumed to produce power to convert ordinary aromatic hydrocarbon mixtures (containing about 14 to 18 percent of ethyl benzene) by the Aromax process to p-xylene reaches 4,800 kilocalories/-kilogram [12]. If the process is changed to the Ebex process, ethyl benzene can be separated from the aromatic hydrocarbon mixture first for isomerization. The energy consumption to produce power to convert it to p-xylene can be reduced to 3,500 kilocalories/kilogram. If the Parex method is used to separate o-xylene and p-xylene, and if they are produced jointly half and half, then, the energy consumed to produce power to convert them into p-xylene can be reduced to 2,400 kilocalories/kilogram. This low conversion into many varieties in joint production also reduces the scale of isomerization and adsorption stripping facilities by 36 percent and 12 percent respectively [13]. The fixed quantities of recovered ethyl benzene and o-xylene both provide raw materials for the chemical industry. The oil conserved in the reduction of energy consumption can also allow the output of p-xylene to basically approach the total productivity of its original process. In the same way, our nation now has over 20 sets of equipment for catalysis and cracking with an annual refining capacity of 600,000 tons. If propylene is recovered and if regional centralized production of acrylonitrile is realized, then the whole nation can increase its production of acrylic fibers by 200,000 tons [14].

Therefore, our nation should develop the superiority of socialism. The petroleum industry, chemical industry, synthetic fiber industry and light and textile industries can develop joint production and cooperation as a four-in-one entity so that oil and various products can be rationally utilized, and the shortage of petroleum can be made up by stopping waste.

4. Improve the depth and broadness of comprehensive utilization

Petroleum and synthetic fiber manufacturing plants must "consume all" oil raw materials and at the same time they must emphasize chemical utilization. Burning coal in boilers and making heavy oil into light oil are important measures to improve the rate of utilizing petroleum. In depth processing, gas produced by refineries frequently constitute 7 percent of the amount of crude oil processed. The Corsob method and such concentration techniques should be used to recover pure hydrogen, pure carbon monoxide and pure ethylene from the released gases for use as chemical raw materials. In the medium and long range planning of synthetic fiber bases, consideration must also be given to establishing nuclear power stations to solve the problem of transporting massive amounts of raw coal.

To reduce the burden of public utilities already borne by petroleum and synthetic fiber plants, comprehensive utilization should first consider synthesizing those products that have a low energy consumption and those that produce a large heat releasing reaction. For example, when synthesizing MTBE (methyl tertiary butyl ether) or TBA (tertiary butyl alcohol) from isobutene, the energy consumed to produce power needed amounts to only 500 kilocalories/-kilogram. When mixing synthetic gasoline with a high octane value, the refinery can reduce the depth of processing and conserve oil two times its own weight. In steam cracking with the same rate of production of ethylene, each kilogram of n-butane can replace 1.5 kilograms of naphtha of 2 kilograms of crude diesel. Synthesis of hexadiamine by butadiene cyanidation or synthesis of butane dicarboxylic acid by carboxylation can also utilize methane, cyan hydride and synthetic gases. All of these have practical significance in improving the utilization of C_4 at petroleum and synthetic fibers plants.

III. Develop Synthetic Fiber Production By Developing Advantages and Avoiding Shortcomings

Synthetic fiber production is a technology-intensive sector, its supply and marketing process is lengthy and its operation is highly repetitive. Therefore, as long as the matched productive links are mutually utilized, energy conservation can be realized. For example, direct spinning of polymerized melts can eliminate the procedures of casting bands, cutting, drying and remelting, and 8,000 to 12,000 kilocalories/kilogram of energy can be conserved. The POY-DTY technique to produce long strands can be directly used in knitting and machine knitting. This will conserve 3,000 to 11,000 kilocalories/kilogram [15] of energy more than using short strands. The POY-ATY technique can also further simplify the technology of feeding the knitting machine. It is estimated that energy consumption and costs can be further reduced. Preparatory coloring in melt spinning or solidified liquid dyeing

in wet spinning have all simplified the process of dyeing synthetic fibers and the amount of energy conserved will reach over 3,600 kilocalories/kilogram [16]. Especially in our nation's coastal regions, if existing favorable conditions of the light and textile industries and technically complete facilities are utilized on the basis of introducing technology to actively improve the technical processes, develop products, create new technologies, then the level of energy consumption in the production of synthetic fibers will surely undergo a new change in outlook. (End)

Previous opinions have been provided by the general plant and the subsidiary plants, the scientific association of the general plant and the Chemical Fiber Engineering Society. This article was reviewed by responsible comrades Qian Chunxuan [6929 2504 2537], Li Dehong [2621 1795 1347], Ye Runqiu [5509 3387 4428] of the Research Academy. We thank them. For details, read "Synthetic Fiber Industry" No 1, 1981.

References

[1] "New Fiber Textiles Monthly", (Taiwan), [1], 1, (1980).

[2] First Polyester Plant of the Shanghai General Petrochemical Plant: "Final Design for DMT 25,400 tons/year", 1974.

[3] Toray Ind. Inc. Hydrocarbon Processing 54 [11] 131, (1975)

[4] Polyester Plant of the Tianjin Petrochemical Fiber Plant: "Final Design for DMT 90,000 tons/year", (1978)

[5] "General Review of the Foreign Petrochemical Industry", p 517, Petrochemical Industry Press, 1978.

[6] Changzhen Chemical Plant of the Yanshan Petrochemical Company: "Final Design of PTA 36,000 tons/year", 1979.

[7] Maruzen Oil - Matsushita Petrochemical Company panel discussion during visit to China, November, 1978, in Shanghai.

[8] Chemical Plant of the Liaoyang Petrochemical Fiber Company: "Preliminary Design of the Nylon Salt Installation", 1975.

[9] "Present Situation of Foreign Chemical Fibers", [348], 1-42 (1978), (Japan).

[10] Acrylic Plant of the Shanghai General Petrochemical Plant: "Manual of the Design for 47,000 tons/year Acrylic Fiber Production", 1975.

[11] Polyvinyl Plant of the Shanghai General Petrochemical Plant: "Manual of the Design of the Polyvinyl Plant of 33,000 tons/year", 1975.

[12] "Present Situation of Foreign Chemical Fibers", [296], 1-42 (1974), (Japan).

[13] "UOP Company Technology Exchange Data", 1978.

[14] Information Center of the Research Academy of the Shanghai General Petrochemical Plant: "Addenda of Scientific and Technological Activities", [10], (1980).

[15] "Journal of the Fiber Machinery Society", 33, [1], 27 (1980), (Japan).

[16] "Present Situation of Foreign Chemical Fibers", [354], 1-41 (1979), (Japan).

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CSO: 4006/279

YUNNAN POWER GRID GENERATES MORE ELECTRICITY

Kunming YUNNAN RIBAO in Chinese 2 Feb 82 p 1

[Article by Yang Liyi [2799 4539 5030] and Yang Xuanmin [2799 6693 3046]: "Lift Up the Spirit and Build Up Stamina; Overcome Difficulties To Attain High Output; Provincial Electric Power System Generates More Electricity in January"]

[Text] The broad number of cadres and workers of the provincial electric power system have lifted their spirits, overcome difficulties, and exerted efforts in production. Up to 29 January, they had completed the generation of over 298 million kilowatt-hours of electricity, this creating the highest level for any similar period in the past.

Last winter and this spring, our province has had a dry season. Water reserves have been insufficient. Hydroelectric facilities could not generate additional electricity, and the task of generating electricity by thermal power stations was heavier. At the end of December last year, the leadership of the Provincial Electric Power Bureau led cadres to go deep into the basic levels to conduct surveys and studies and held a system-wide cadres conference. They conscientiously analyzed the production situation and established concrete measures to guarantee completion of the task. After 1 January, the leadership of the bureau again went to the localities with concerned departments to implement fuel supply and to guarantee the need for coal by each thermal power plant. At the same time, they conscientiously inspected and repaired equipment. In January, they inspected and repaired 23 units of machinery and boilers, 3 substations, and 11 high-voltage transmission lines, and created good conditions for the safe generation and supply of electricity.

The cadres and workers of this system stayed at their posts with the spirit of being the master and generated more electricity and supplied more electricity. The Xuanwei power plant had a heavier task in generating electricity this year. The workers of the whole plant thought of all kinds of ways to develop potential. Generators were inspected and repaired according to plan, and all other generators began operation. The highest daily output of electricity in January reached 3,812,000 kilowatt-hours, an unprecedented figure during the same period in the past. During the two holidays in January, leading chadres and engineering and technical personnel of the various production units of the system insisted on working with the shifts to direct production, and they contributed efforts to guarantee the supply of electricity for industrial and agricultural production and for the needs of the people in the whole province.

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CSO: 4008/101

500,000-VOLT LINE ADDED TO HUBEI ELECTRIC POWER SYSTEM

Wuhan HUBEI RIBAO in Chinese 23 Dec 81 p 1

[Article by Zhang Yuexing [1728 2588 5281]: "A Key Project in Our Nation's Buildup of the Electric Power Industry, the 500,000-volt Ultrahigh-Voltage Pingwu Power Transmission and Transformation Line Joins the Power Network and Begins Transmission"]

> [Text] Editor's Note: The Pingwu 500,000-volt ultrahigh-voltage power transmission and transformation line has been built quickly and well, and has now officially joined the power network and begun transmission. This is the result of the collective wisdom of the builders of this project. It is also a glorious victory in conscientiously implementing the policy of readjustment of the national economy. It has important significance in promoting industrial and agricultural production in the central China region and in guaranteeing electricity for the livelihood of the people. It is a welcome [event]! It is a cause for celebration!
>
> We enthusiastically hope that the builders participating in this project will continue to retain and develop their honorable style of being of one heart and one mind and of working together, as well as their courageous spirit and their attention to science so as to manage and use this new equipment and new technology well, and make even greater contributions to advance the work of the four modernizations.

The key project in our nation's buildup of the electric power industry--the Pingwu 500,000-volt ultrahigh-voltage power transmission and transformation construction project--has officially joined the power network, and began transmitting electric power on 22 December. From now on, the electricity for all businesses in our province (including the Wugang 1.7-meter steel roller) and the electricity for daily living of the people of our province is guaranteed, unless a unique accident occurs.

In the past, the powerlines with the highest voltage in our province were several 220,000-volt power transmission lines. When the power transmission line is long, the electricity at the end becomes reduced. The Pingwu project,

a main trunk of the Central China Power Network, is a power transmission and transformation project that has the highest voltage, spans the longest distance (600 kilometers), has the largest transmitted power, and is the most technically advanced. It includes three large booster stations and substations, the Henan Pingdingshan Booster Station at the starting point, the Zhongxiangshuanghe Substation, and the Wuchang Fenghuangshan Substation at the end. Its completion has connected tightly the power networks of Henan and Hubei provinces. It can coordinate with the Gezhou Dam Hydroelectric Power Plant to transmit electricity outward and coordinate the hydroelectric power of Hubei and the thermal electric power of Hunan. During peak flooding seasons, it can conserve coal and petroleum energy resources, improve the stability and reliability of the power supply of the Central China Power Network system, and assure a supply of electricity for the Wugang 1.7-meter roller and for industrial and agricultural production in the central China region and for use by the people. Because it is computer controlled, it also rasies the level of automation of management and control of the power network in central China.

With the cooperation of more than 8,000 builders in scientific research, processing, manufacturing, construction, and logistics, progress on the project was the fastest in the nation. The quality was tested successfully with one special effort, and it meets the designed requirements. The cost has thus been reduced by 15 to 20 percent, conserving an investment of 15 million yuan. The whole project was built quickly, the quality is high, and the economic benefits are good.

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CSO: 4008/101

INCORPORATION OF SMALL HYDROELECTRIC STATIONS INTO BIG POWER GRIDS

Beijing NENG YUAN [JOURNAL OF ENERGY] No 1, 25 Feb 82 pp 15-17, 37

[Article by Consumption Division of Electric Power Bureau, Guangdong Province: "Some Suggestions Concerning Correct Treatment of Contradictions in the Network Incorporation of Small Hydroelectric Power Stations and Big Power Network"]

[Text] Shortage of electric power supply in Guangdong Province is a problem that has existed for a long time. Although a large number of large-, medium-, and small-scale hydroelectric and thermoelectric power plants were built one after another, the supply of electricity still falls short of demand made by socialist production and construction and people's daily lives. It is absolutely necessary that the hydropower resources of the province be fully developed and utilized by systematically building small hydroelectric power stations in order to supplement the shortage of network electric power. According to incomplete 1980 statistics, the total installed capacity of all small hydroelectric power stations which have already been incorporated into big power networks amounted to 286,500 kilowatts. These small hydroelectric power stations transferred a total of 56.6 million kW-hr of electricity (not including figures for Dunshou County) into the network, which amounted to 6.79 percent of the annual electricity supply of the big power network, and thus had definite impact on easing the electricity shortage. We cannot deny this. However, we must also recognize that, with encouragement and support, the construction of small hydroelectric power stations suddenly proliferated, and they are no longer operating according to the principle of "generating electricity for self-consumption, in the villages, for local consumption and balance." Since construction of small hydroelectric power stations lacks an overall plan, many contradictions showed up during the process of constructing these small hydroelectric power stations and incorporating them into big power network. We must take these contradictions seriously and try to find rational solutions if we want to get the full benefit of all the electric power stations --large, medium, and small.

1. How To Evaluate Correctly the Impact of Small Hydroelectric Power Stations

In remote areas where big power network services are not available, it is necessary and correct to utilize locally available hydropower resources, by doing what local conditions dictate and focusing on the small and scattered demand characteristic of rural areas, to provide electricity to the remote

areas by the local means. This helps solve the problem which cannot be solved by the big power network temporarily. It is also necessary to develop small hydroelectric power stations to supplement big power networks to conserve a definite amount of coal and oil for the nation.

However, can we solve the electricity shortage of Guangdong Province by relying mainly on the development of small hydroelectric power stations? The capacity of existing large- and medium-scale hydroelectric power stations is 40 percent of the total combined hydro- and thermoelectric installed capacity (counting only those plants belonging directly to the provincial electrical power bureau). Of these, there are only two plants--Shinfengjiang and Nanshui--which belong to the perennially regulated type of hydroelectric power plant. Because of the large share of hydroelectric power, there is shortage of electricity over 5-6 months each year during the dry season and the situation is especially serious during the first quarter. In addition, every day, the shortage is concentrated in the two peak load periods, one in the morning and one in the evening, and there is surplus of electricity during the low-demand period in the middle of the night. However, transfer of electricity from small hydroelectric power stations to the big power network occurs mainly at midnight and during dry season many small hydroelectric power stations will either reduce or stop generating electricity. Thus, they often run counter to the needs of the network to solve the shortage problem. For example, in the Shantou area, where electricity generation depends mainly on the medium- and small-scale hydroelectric power stations, a large part of industry must be shut down during the dry season; even electricity for illumination of the urban Shantou area is in short supply. After it was incorporated into the electric power network, the industrial production of the entire area over a period from January to July 1981 increased 12.84 percent over that of the same period in 1980, and electricity for people's daily lives was guaranteed. This proves that the normal demand on electricity made by agriculture, industry, and people's daily lives cannot be satisfied if we rely mainly on the medium- and small-scale hydroelectric power stations. Therefore, we must never repeat the past mistake of making hydroelectric power the major and thermoelectric power the minor source of electricity.

2. What Are the Contradictions Arising From Incorporating Small Hydroelectric Power Stations Into the Network?

During the period in which small hydroelectric power stations were springing up rapidly in Guangdong Province, the situation became distorted. That is to say that small hydroelectric power stations were blindly built in large numbers, aiming to achieve only a large installed capacity without much consideration for the conditions required for incorporation or the needs of big network operation. As a result, after they were incorporated, various contradictions surfaced one after another, which not only hindered the development of the small hydroelectric power stations but also discouraged the electric power supply departments of various areas to purchase electricity from the small hydroelectric power stations. Therefore, we must investigate the matter carefully in order to understand the problems concerning incorporation of small hydroelectric power stations. We must analyze and find out the causes of these contradictions and try to solve these problems successively in order to be able to build and manage small hydroelectric power stations better in the future.

The contradictions that exist today consist mainly of the following.

1) The contradiction related to the amount and the time of electricity generation: The basic feature of electric power generation is the fact that generation, distribution, and consumption take place simultaneously, and the product cannot be stored. Small hydroelectric power stations generate electricity seasonally. They can generate electricity only during the wet season and none at all or very little during the dry season, which lasts more than 6 months. Take Longmen County, for example. The total installed capacity of all small hydroelectric power stations in the county amounts to 21,000 kilowatts, with an annual electricity generation capacity in excess of 50 million kW-hr, while the annual electricity consumption of the county is only 42 million kW-hr. On the surface, this county appears quite self-sufficient with its small hydroelectric power stations supplying all its electricity needs with some to spare. In reality, this county generated 45 million kW-hr of electricity in 1980, it consumed 30 million kW-hr, and transferred 15 kW-hr million kW-hr into the network. However, during the dry season, it received 60,000 kW-hr of electricity each day from the network. During the wet season, the Meixian area, except for Xingning County, has surplus electricity transferred into the network, as much as 44 million kW-hr last year. However, during the dry season, every county must get electricity supplied by the network. It is evident from this that, no matter how big the installed capacity may be and no matter how much electricity may be generated annually, they cannot solve the shortage of electricity during the dry season by themselves. This is the weakness of hydroelectric power generation. Therefore, those areas, which used to be self-sufficient with their own small hydroelectric power stations and are now incorporated into the network, are not only unable to help ease the electricity shortage situation during the dry season but, on the contrary, add load to the big power network.

2) Small Hydroelectric Power Stations Generate Much Electricity While Large Power Stations Throw Water Away

The absolute majority of the small hydroelectric power stations incorporated into the power network belong to the through-flow type of power station, so their power generation cannot be planned, nor are they uniformly regulated by the network. During the wet season, they generate more electricity than they can use and transfer the surplus into the network regardless of the need for electricity by the network. During the midnight load period in particular, when the demand for electricity drops in the areas served by the small hydroelectric power stations, large amount of electricity is transferred into the network making the valley load of the network even lower. For example, starting on 7 April 1981, it rained continuously for days. The electricity generation and the generation load of the network before and after the rain showed a significant change. The actual figures on the 7th and 13th are compared in the following table.

Date	7 April	13 April
Daily electricity generation by the network (10,000 kW-hr)	2,592.78	2,278.42
Maximum load of the network (10,000 kilowatts)	130	123
Midnight load of the network (10,000 kilowatts)	89	75
Network load factor (%)	83.1	76.5
Electricity generated by large- and medium-scale hydroelectric power stations of the network (10,000 kW-hr)	879.46	674.94
The above as the percentage of total (%)	33.92	29.62

It is evident from these figures that the electricity generated and the generation load of the network droppped as a result of large input of electricity from the small hydroelectric power stations. The drop was most significant during the midnight load period. On the night of 2 August, the midnight load continued to drop to 610,000 kilowatts, so each thermoelectric plant of the network had to shut down 1-3 boilers in order to reduce electricity generation and to let the small hydroelectric power stations input power to the network. As a result, thermoelectric power plants had to repeatedly shutdown and restart boilers, which is not conducive to safe production and more fuel is spent when boiler is shut down and restarted frequently. At the same time, many large and medium hydroelectric power stations must also reduce power generation and ended up throwing away a large quantity of water. According to the statistics, more than 755 million cubic meters of water were unused by the two hydroelectric plants at Changhu and Cuanshin during a period from April to June, equivalent to a loss of 94 million kW-hr of electricity. The network load factor also plunged from 83 to 76.5 percent.

3) Small Hydroelectric Power Stations Generate More Active Power and Less Reactive Power

During the wet seasons, the phenomena of small hydroelectric power stations generating more active power and less reactive power become widespread. According to the regulation, the power factor of electricity transferred by the small hydroelectric power stations to the network must be 0.8. However, the actual figures show that the daily power factor was in the range of 0.96-0.97 during the months of May and June in Longmen County. In the Fushan area, the power factor of electricity generated by the small hydroelectric power stations during the wet season was also greater than 0.95. As a result of an increase in the power factor, more active power can be delivered. Although there is a penalty of 1.5 fen per kW-hr of reactive power below the norm, after the two are balanced out, the small hydroelectric power stations still come out ahead economically. If the power factor is increased to 0.95, the average per kW-hr income can be increased from 6 to 6.3 fen.

However, due to lack of reactive power, the electric voltage dropped and the customer could not be served. The network suffered a greater transmission loss because a large amount of reactive power had to be transferred over a long distance. Large and medium electric power stations were obliged to generate more reactive power and less active power. Thus, not only was more fuel consumed, the operation also became more unstable, and, above all, the

principle of local compensation of reactive power was violated. On the other hand, during the dry season, when the hydroelectric power stations cannot generate electricity due to lack of water, some small hydroelectric power stations, without any plan, transfer reactive power into the network in order to increase their income. Such practice causes a surplus of reactive power in the network and excessively high voltage on the line, degrading the quality of electricity and endangering the safety of the consumer.

4) Transmission Loss of the Network Increased

When electricity is transferred from small hydroelectric power stations into the network, it undergoes many stages of transformer stations where the voltage is boosted and then reduced. In addition, small hydroelectric power stations are often located in remote mountainous areas, so the transmission line tends to be long and the transmission loss huge. For example, a small hydroelectric power station in the northern part of Yangshan County transferred its electricity over a 10-kilovolt, 58-kilometer-long transmission trunk line. Because the cross-section of the cable is small, the loss amounted to as much as 41 percent.

5) Irrational Electricity Price

According to the regulation, 6 fen per kW-hr is paid to the small hydroelectric power stations for the electricity they supply to the network. Based on the prevailing average sale price of electricity of 7.5 fen per kW-hr, it appears that the network is making some profit by buying electricity from the small hydroelectric power stations. The reality is that not only no profit is made, the network loses because the network must bear the 15 percent tax on all electricity sold and all the expenses of distribution cost and the transmission losses. Take the three counties of Qinyuan, Sihui, and Enping, for example.

In 1980, Qinyuan County bought 9.979 million kW-hr of electricity from the small hydroelectric power stations and lost a total of 177,900 yuan; Sihui County bought 37.729 million kW-hr and lost 770,000 yuan; and Enping County bought 34.937 million kW-hr and lost 510,000 yuan.

According to an incomplete statistics, big power network bought in 1980 a total of 566 million kW-hr of electricity and lost a total of 5.1 million yuan. The number of small hydroelectric power stations is expected to increase further in the future, and so will the loss of big power network. This is one of the major contradictions that exist today concerning incorporation of small hydroelectric power stations into big power network.

Because the price on electricity generated by small hydroelectric power stations is set disproportionately high, the profit of the small hydroelectric power stations is too high. For example, the profit made by the small hydroelectric power stations in Longmen County in 1980 amounted to 1.03 million yuan. Its Hepai hydroelectric power station belongs to medium-scale hydroelectric power plant. Because its electricity was paid 6 fen per kW-hr according to the rate applicable to the small hydroelectric power stations, it made a profit of more than 4 million yuan in a year. Thus, a situation in which small hydroelectric power stations making profit while big power network losing profit has been created. Protecting the benefit of the small hydroelectric power stations one-sidedly can only stimulate the initiative of one side and not the initiative of both sides. This is in violation of a basic economic law.

	Average income from sale of electricity (fen/kw/hr)				Price of electricity (fen/kw/hr) purchased from small hydropower plant			Comparison of income and expenditure
		Deductions						
Name of County	Average Unit Sales Price	Tax 15%	Redistribution cost	Net income per kW/hr	Purchasing price plus transmission loss fee	Reactive power fee for small hydropower plant	Total purchase expenditure	Gain (+) Loss (-) (fen/kw/hr)
Qingyuan	7.483	1.122	0.582	5.779	6.938	0.624	7.562	-1.783
Sihui	7.802	1.17	0.637	5.995	6.983	1.05	8.033	-2.038
Enping	7.444	1.117	0.772	5.555	6.640	0.373	7.013	-1.458

6) Development of Small Hydroelectric Power Stations Lacks Unified Planning

Construction of small hydroelectric power stations in the past was done quite independently without any unified overall planning. Each one considered only the installed capacity and neglected the length of transmission line and the diameter of the transmission cable, and little attention was paid to the capacity of transformer stations and their rational disposition. Therefore after the station was built and electricity generated, they discover too late that the transmission line losses are too big, or worse, the transformer capacity is too small to transfer all the surplus electricity. For example, a small hydroelectric power station in Yangshan County has a total installed capacity of 20,000 kilowatts, but there are only two transformer stations in the entire county providing linkage with the big power network with a combined total transformer capacity of 10,500 kVA. After a portion of electricity generated is consumed locally, approximately 5,000 kilowatts of surplus power cannot be transferred into the big power network during the wet season. Thus, 13 million kW-hr less electricity is generated each year, wasting precious hydropower resources. In addition, because of lack of rational planning, the disposition of the power stations and the transmission lines are mismatched, resulting in transmission losses as high as 41 percent. Because there is too much surplus electricity to be disposed of, the small hydroelectric power stations compete with one another to sell their electricity by raising the transmission voltage from 400 to 500 volts, and thus causing damage to the user's equipment due to excessively high voltage. As a result, this county suffers the consequences of a mismatch between generation, transmission, and consumption characterized by electricity cannot be generated as much as it can during the wet season, poor quality of electricity, and severe shortage of electricity during the dry season. This constitutes the most lively example of the consequences of unplanned, blind construction of small hydroelectric power stations.

3. Some Opinions

1) Set the Course Straight and Continue To Develop

Adjustment guidelines be implemented so that maximum benefit may be gained from expenditure of least amount of money. First of all, we must fully utilize the potential of the existing small hydroelectric power stations, by increasing and expanding the reservoir capacity to increase the output, reorganizing the transformer stations and the transmission lines to match the capacity, and strive not only to increase the utilization rate but also to make the system capable of transferring as much power as need to be transferred.

Furthermore, future construction of small hydroelectric power stations must conform to the principle of "generating electricity for self consumption, in the villages, for local consumption and balance," with emphasis on the remote areas where the network services are unavailable just to satisfy the demand made by the local production and daily lives.

To solve the shortage of electricity in the big power network, we must do it mainly by building large and medium thermoelectric power plants and larger than medium hydroelectric power stations with good adjustment performance.

This must be supplemented by a number of multistage hydroelectric power stations built in areas where there is a large volume of water available and the flow can be regulated by a reservoir in order to conserve fuel.

2) Unified Planning

In making plan for the construction of small hydroelectric power stations, the construction conditions and economic benefit as well as coordination with the supportive facilities such as transmission line and transformer stations must be taken into consideration and rational arrangement must be made for the entire region. Before making attempt to incorporate with big power network, the conditions for incorporation must be carefully studied. The local electricity supply department must be consulted ahead of time to make unified plan and to negotiate the details, in order to avoid bottle neck phenomenon resulting from too small cable or insufficient transformer station capacity from ever taking place again.

3) Improving Grid Management

Before incorporation into the network, the small hydroelectric power stations must sign an agreement about matters related to incorporation such as generation and transmission. Hydroelectric power stations with regulatable reservoirs must be uniformly regulated by the network control according to the network load requirement.

4) Reconstruct the Price Structure Rationally

The price for purchasing electricity from small hydroelectric power stations today is set uniformly at 6 fen per kW-hr, which is somewhat too high and thus is detrimental to promoting two initiatives. A new electricity price structure must be established based on the principle that the network is to recover only the cost without making a profit. The price of electricity ought to vary according to the seasons, peak and low-demand namely different prices at different times, in order to have small hydroelectric power stations generate more electricity during the dry season and the peak load period of the network and to fully demonstrate the impact of small hydroelectric power stations.

Those small hydroelectric power stations which have already been built and are unable to pay back the loan at once, ought to be assisted by some other means and not by means of raising the price of electricity. The electricity generated by the medium hydroelectric power station should not be priced the same as that of small hydroelectric power stations.

5) Transmission Line Losses

The Watt hour meters ought to be installed at the dividing line between two properties.

According to the nature of utilization of right-of-way of the transmission lines and the transformer stations, the dividing line between the network and the individual line must be clearly drawn and each party must bear its own transmission losses and its maintenance cost.

6) Reactive Power Problem

Small hydroelectric power stations must transfer electricity with a power factor of 0.8. The discrepancy in the reactive power must be deducted from the active power before calculating the fee. The purpose of doing this is to encourage local compensation of the reactive power. When there is deficiency of reactive power in the network, the small hydroelectric power stations must according to the dispatch send in reactive power and the fee should be calculated according to the price of reactive power.

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CSO: 4013/50

GUANGDONG POWER SUPPLY FACES OBSTACLES IN 1982

Guangzhou NANFANG RIBAO in Chinese 7 Mar 82 p 2

[Article by Reporter Wang Dekuan [3769 1795 1401] and Correspondent Li Peixun [7812 0160 8113]: "What Is the Situation of Our Province's Power Supply This Year? Power Output Will Increase by 300 Million Kilowatt-hours Over Last Year, But There Is a Greater Shortage of Coal and Fuel. Use of Electricity Beyond Plans Is Widespread, Conserving Electricity Is Urgent"]

[Text] Last year, our province's power industry realized two gains and one reduction--the good results of increased power output and profits submitted to the higher authorities and reduced consumption of fuel and coal. The output of power increased by more than 800 million kilowatt-hours over the year before last. If each kilowatt-hour of electricity can increase the value of industrial production by 3 yuan, then this increased output can increase the value of industrial production by more than 2 billion yuan. It can be said that last year, the workers of the power department fought a beautiful battle. What, then, is the power supply situation in our province this year? Recently, we visited the responsible comrades of the provincial power department. According to their explanation, the trend is good. This year, our province plans to increase the output of electricity by about 300 million kilowatt-hours on the basis of last year's output. If the work of the electrical power departments and other departments is done better, there will be even greater increases.

This year, there are many favorable conditions for our province's electric power departments to produce well. The amount of water stored in the reservoirs of all major hydroelectric power stations of the whole province is relatively good. The water level is generally higher than past years. For example, the water level of the Xinfengjiang Hydroelectric Station, our province's largest hydroelectric power station, is more than 20 meters higher than the lowest water level during the ten years of upheavals and is higher than last year's by more than 3 meters. This is very beneficial to generating more electricity. In thermal power, Huangpu Power Plant -- our province's major thermal power plant --added a 125,000-kilowatt generator last year. This year, it will be able to generate over 200 million kilowatt-hours of electricity more than last year. In recent years, every power generating department and power supply department has technically improved the power supply lines, substations, generators and established a good foundation for safe generation and supply of power and conservation of energy. For example, the Guangzhou Power Plant changed from the original generation of electricity only to supplying both heat and

electricity. At the end of the first quarter, it will be able to supply steam to nearby factories. This year, this plant will generate nearly 100 million kilowatt-hours of electricity more than last year.

But this year, some unfavorable factors are present in the electric power industry of our province. This year, there are no large generators that will join in production. The shortage of fuel and coal for generating electricity is also large. For example, if Shaoguan Power Plant can obtain enough raw coal this year, it can generate 100 million kilowatt-hours of electricity more. On the other hand, at present, because the urban power network is old, the conduction lines are small, the capacity of transformers is not enough, the voltage is low, the loss on the line is large and safety and reliability are also poor. At the same time, the use of electricity over the plans by some regions and units is widespread. Families also use a lot of electricity. In this way, the safe and economical operation of power equipment is affected. Therefore, concerned leading departments have asked everyone to overcome the difficulty together to change unfavorable factors into favorable factors. The broad number of electric power workers that shoulder the task of generating and supplying electricity must not hesitate to increase output and conserve, manage power production well, realize economic gain, hasten the steps of capital construction and carry out technical improvements. The hydroelectric sector must realize rational control, and exert efforts to reduce the amount of water used for generating electricity. It must manage small hydroelectric power plants that have joined in the power network to better develop the gain of the small hydroelectric power stations. Thermal power plants must fully develop the function of the generators with a high efficiency, carry out measures to conserve oil and conserve coal and to produce more electricity with a limited amount of fuel and coal. According to the requirements of the provincial power department, this year, the consumption of standard coal for generating each kilowatt-hour of electricity must be 12 grams less than last year. If this requirement is realized, the whole province will be able to conserve 80,000 tons of standard coal and this will increase the output of electricity by more than 200 million kilowatt-hours. The expansion of the Shaoguan Power Plant for a 200,000-kilowatt generator and the large Shajiao Thermal Power Plant in Dongwan should also quicken the steps of construction. The urgent task at present is that each region, each unit and individual must establish an overall viewpoint and use electricity according to plans so that our limited amount of electricity can be used in the most needed places.

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CSO: 4013/34

BRIEFS

SICHUAN-GUIZHOU POWER GRID--The Guizhou and Sichuan power grid went into operation on 2 March. Within the power grid of Sichuan, hydroelectricity generating units play an important role. However, there is a seasonal shortage of power supply. In Guizhou, hydroelectricity and thermoelectricity are more balanced. Since the operation of the two 210-megawatt hydroelectricity generating units, there is an excess supply of power. To promote economic effect, the electric power department and the people's government of the two provinces attached great importance to enhancing cooperation. After several negotiations, it was decided that Guizhou should provide electricity for Sichuan. In November last year, a 220 kilovolt high voltage grid system connecting Qijiang in Sichuan and Zunui in Guizhou was established. On 2 March, electric power was successfully transmitted to Sichuan. At present, the Guizhou power grid supplies 30 to 50 megawatts daily to Sichuan. This will certainly ease the shortage of power supply in Sichuan. [Guiyang Guizhou Provincial Service in Mandarin 2315 GMT 4 Mar 82 HK]

CSO: 4013/42

MODERNIZATION OF CHINESE HYDROPOWER CONSTRUCTION DESCRIBED

Beijing SHUILI FADIAN [WATER POWER] in Chinese 12 Jan, 12 Feb, 12 Mar 82

[No 1, 12 Jan 82 pp 3-7]

[Article by Scientific and Technical Committee, Ministry of Electric Power: "The Place of Hydroelectric Power Among China's Energy Resources, and Policy on its Development"]

> [Text] Recently some readers have written expressing a desire to understand the current status of our country's hydroelectric power construction, the distribution of resources, the technical and economic policy for their development, and developmental prospects. We publish this article, written by the Scientific and Technical Committee of the Ministry of Electric Power, as a service to our readers. We plan to publish this information, which includes a general survey, a description of the advantages of hydroelectric power and its place among our country's energy resources, a description and evaluation of this country's hydroelectric resources, the geographical distribution of hydroelectric power construction, and measures to speed up construction, and a discussion of several technical and economic policies, in three issues of this magazine.

I. General Survey

A. Development of Hydroelectric Power Since the Founding of the State

In surveying the development of hydroelectric power in the 32 years since the state was founded, we can note achievements, interference and hopes.

The achievements are embodied in the fact that under the leadership of the party and with the efforts of the broad masses of workers, cadres and technical personnel, the entire country's hydroelectric resources have been surveyed, a huge amount of planning, site investigation and design and research work, has been done, and a large number of hydroelectric stations of all sizes have been built, providing great impetus to the development of the national economy.

Although the conditions under which some of the early projects were built were rather poor, a concerted effort was made to keep to the production program, and construction time was only 3 to 5 years, with relatively small investments. In 1949, installed hydroelectric power equipment accounted for 9 percent of total installed capacity, in 1956 the figure was 23 percent, and by 1971 it had risen to 30 percent; it has now decreased slightly. Although development in the more recent period has been relatively slow, there has been some increase in the overall scale. In 32 years, total installed hydroelectric generating capacity has increased from 160,000 kW to more than 20 million kW, or by 125 times. The technical standards of our country's hydroelectric construction have been greatly improved, and with our own capabilities we can construct different types of dams more than 100 meters high and hydroelectric stations with capacities of more than a million kilowatts. We have developed a strong planning-design and scientific contingent and a strong construction force.

The interference involved the sabotage and meddling of the ultra-"left" line in hydroelectric construction, as in other fields (although to an even more serious extent) from the late 1950's on. During the Great Leap Forward, "blind command" replaced a scientific attitude; during the anti-rightist tendency, "large-hydroelectric-power-ism" was criticized and hydroelectric power was in disrepute; during the 10 years of chaos, design and research units were disbanded and their members dispatched to the grassroots, construction brigades were moved all over the map, and people's thinking was thrown into confusion, so that overall planning was not done correctly, construction began to take longer and longer, investment expenditures increased, and the reputation of hydroelectric construction was seriously damaged.

As for the hopes, since the smashing of the "gang of four," the advantages of hydroelectric power generation and its place in our country's energy resources have been increasingly recognized. The central leadership has frequently pointed out that hydroelectric power development should be actively pursued and given a high priority. Hydroelectric power construction brigades are being readjusted and reorganized, and recently a conference was held on hydroelectric power construction preparatory work and project quality management in order to make preparations for speeding up hydroelectric power construction. We trust that with unity of ideas and energetic effort, hydroelectric power will make its proper contribution to development of the four modernizations.

B. The Relationship of Hydroelectric Power to the National Economy

Experience makes it clear that the faster hydroelectric power is developed the more benefit acrrues to the national economy. Increased development of hydroelectric power will yield a corresponding saving in consumption for fuel extraction, will mitigate the coal and oil shortages, and will conserve some precious energy for succeeding generations. Water power is a renewable resource; however, if it is not immediately utilized, but instead is allowed to flow away, in reality coal and oil are flowing away, which is a great shame. Hydroelectric stations not only represent a way of developing energy resources, but also are installations for converting water power into a secondary energy resource, electrical energy. After they are connected to the power grid, they

can furnish large quantities of low-cost electric power and this flexible, reliable electricity supply can take on such tasks as load and frequency adjustment. Cheap electric power can also foster the development of the electrochemical and electrometallurgical industries, respond to domestic and foreign markets, decrease imports, help increase exports, and accumulate foreign exchange, which is much more profitable than exporting our country's scarce petroleum and coal. Hydroelectric stations built on the rivers generally offer comprehensive-utilization advantages for flood prevention, irrigation, navigation, water supply, fishing, tourism and the like, and thus promote the development of other departments of the national economy.

Priority development of hydropower is a policy that has been widely adopted by other countries. Many developed countries actively expanded cheap hydropower during their development, producing great benefits for economic expansion. Recently some developing countries have been energetically expanding hydropower, thus setting their entire national economies in motion. Our extremely plentiful hydropower resources place us first in the world, but the rate of their development is far below the world level, and there is great unused potential. Stepping up hydroelectric construction and actively utilizing our country's plentiful water power resources will unquestionably have a major effect on the national economy.

C. Main Problems in Hydroelectric Construction

There are still many problems in priority development of hydropower resources and accelerated hydroelectric station construction.

An external factor is insufficient investment funds. The investment funds allocated by the state to the power industry must be used primarily to support projects which will become operational in 2 to 3 years, which means more fossil-fired plants; the remaining amount of investment funds is not large, so that hydroelectric power has had trouble making progress. Ten years ago this situation caused hydropower's share of generating capacity to decline gradually. If the situation continues, the relative share of hydropower will be in danger of continuing to decline for the next 10 years. Comrades involved in hydroelectric power frequently comment sadly, "Although hydroelectric power is good, there aren't enough investment funds." If the state develops it as another energy source on a par with coal and petroleum and increases investment in it, its rate of development will unquestionably increase.

There are also internal factors. At present, preliminary work is lagging behind, it is difficult to reconstitute the disbanded design and research units, there are not enough follow-up units, the construction brigades are getting old and construction efficiency is rather poor, and the problems of inundation of land and relocation of inhabitants associated with reservoirs are very difficult to solve. Every effort must be made to overcome these problems in order to create the conditions for accelerated hydroelectric construction.

II. Advantages of Hydroelectric Power and Its Place Among Our Country's Energy Resources

A. Hydropower Is One of Our Country's Three Major Conventional Primary Energy Sources

In the past, when some comrades spoke of primary energy sources, they meant only coal, petroleum and natural gas, considering hydroelectric power as a secondary source. This was incorrect. Most foreign systematic documents treat hydropower as a primary energy resource. Recently some foreign articles have been naming only coal, petroleum, natural gas and nuclear power. This is because Japan, the United States and the European developed countries have almost fully exploited their hydropower resources; since hydropower development has a very small share of future energy resource development, it is not discussed. Our country has extremely plentiful hydropower resources and their development occupies a rather important place in our energy resource utilization, so that it must not be neglected. Accordingly, this article includes hydropower along with coal, oil, natural gas and nuclear power as a primary energy resource, indicating that we make the correct evaluation of hydropower in relation to our country's specific situation.

According to the latest comprehensive surveys, our country's theoretical hydropower potential is 680 million kW, equivalent to 5.9 trillion kWh. Total developable hydroelectric potential is 370 million kW, which corresponds to 1.9 billion kWh per year and is equivalent to the consumption of 700 million tons of standard coal, 1 billion tons of raw coal or 500 million tons of crude oil a year in fossil-fired stations. Over 100 years, this would be equivalent to 100 billion tons of raw coal or 50 billion tons of crude oil, which are sizeable quantities. This does not take account of the question of expenditures in coal and oil extraction systems. It is clear that we should rank hydropower along with coal and petroleum as one of the three major primary energy resources, having extremely great significance.

Our potential coal reserves are also very great, placing us third in the world. Our potential petroleum reserves are now the subject of extensive exploration, and they too show promise. But in addition to being energy resources, coal, oil and natural gas are also important chemical engineering raw materials and strategic materials, and it would be a shame to burn them up as fuel; furthermore these fuels are currently used with rather low thermal efficiency. Accordingly, doing everything possible to utilize our great undeveloped hydropower resources as a replacement for precious fossil resources, which can then be preserved for future generations, is a strategic matter which requires far-seeing, comprehensive consideration.

B. Hydropower Resources Are the Technically and Economically Most Favorable Renewable Resources

Hydropower resources are constantly renewed by the hydrologic cycle (precipitation--runoff--evaporation--precipitation), while such mineral energy sources as coal, oil, natural gas, uranium and thorium were formed through eons of geological change and are not easily renewed, so that they are generally called

"nonrenewable resources." Every country or region has a certain reserve of them which is decreased by the amount which is used: the more of them is used, the less remains. This is not true of hydropower resources: if they are not utilized they are wasted, which is equivalent to wasting energy, while if we utilize them we are making natural resources create wealth for mankind, in addition to which they can be used for a long period without being diminished.

Other renewable resources such as solar power, wind power, tidal power, wave power and the like are geographically dispersed and highly variable over time. Their development and utilization is still in the research and experimental stage, and under currently foreseeable technical conditions their development cost will be extremely high. Firewood forests, methane and the like are extremely important for providing energy in the countryside, but are difficult to use in industry or in the cities.

Hydropower is a technically mature, conventional renewable energy resource which has been used effectively for the past hundred years. It is economically superior to other energy resources and should be developed and utilized first.

C. Developing Hydropower Is an Effective Measure to Alleviate Oil and Coal Shortages

Since the 1973 world energy crisis oil prices have mounted rapidly, and recently coal prices have also been rising fast, so that many countries have an energy shortage. Oil-importing countries are all taking the step of replacing oil with coal or hydropower, and even though developed countries such as the United States, the European nations and Japan have only a few remaining unexploited hydroelectric power localities, they are energetically developing medium- and small-scale hydropower; some developing countries such as Brazil and India are even more energetically pursuing hydropower in an effort to decrease their dependence on fuels imported from abroad. Such petroleum-exporting countries as Venezuela and Mexico are also energetically developing hydropower to conserve on their own petroleum consumption, increase exports and accumulate foreign exchange.

In recent years our country has had a considerable energy shortage, and it will be hard to fundamentally alter the situation for some time to come. The power industry is a major user of coal and petroleum, and when these are inadequately supplied the industry's development is limited. The supply of energy and electricity will determine the speed of our country's future economic development. Replacing electric power produced from oil and coal by hydroelectric power is an effective means of alleviating our country's petroleum and coal shortages.

D. Hydroelectric Construction Represents a Simultaneous Realization of Primary and Secondary Energy Resources

Building hydroelectric power stations, which can convert hydropower, a primary energy resource, into electricity, a secondary energy resource, is equivalent to the entire process of building coal mines, coal hauling railroads and fossil-fired electric power stations. If we consider capital construction expenditures and construction periods in these terms, the two alternatives are

approximately equivalent. Building a hydroelectric power station requires construction of a large dammed reservoir or tunnel, involving a rather large investment and long construction periods; fossil-fired power stations require construction of coal mines and coal-hauling railways from them, involving a rather large investment, and construction of a large coal mine also requires a long time. Of course, large-scale hydroelectric stations generally are rather distant from energy-using centers, as are pithead fossil-fired stations: the investment in power lines and the construction period must be taken into account in both cases. In the past, only the capital construction investment and construction time of fossil-fired power stations was compared with that of hydroelectric stations; the latter clearly take greater expenditures and longer construction times, but this is not a correct comparison. The same approach has been taken in state allocation of capital construction investments, with the result that hydropower has been unable to take its rightful place.

Hydroelectric power is an energy resource requiring one-time construction; once a station is built it uses natural water to generate electricity and no expenditure on fuel is required. Construction requires intensive labor and a rather large labor force, but when construction is completed, labor expenditures during operation are very small and the overall labor productivity is rather high. After coal mines, coal-hauling railroads and fossil-fired power stations are constructed, during operation there is a continuous necessity to open up work faces, cut the coal, haul it, burn it and remove the ash, requiring a continuous expenditure of labor, and the overall labor productivity is rather low. In-house electricity use and losses in the process, from coal extraction, washing and transport to power plant operation, are greater than those for hydroelectric stations (including transmission losses).

During the comprehensive balancing of the long-term national economic plan it will be necessary to treat hydroelectric power as a primary energy resource along with coal and oil and to take account of the fact that it can also be converted into a secondary energy resource if we are to upgrade hydroelectric construction.

E. Hydropower Is Cheap Power

Once a hydroelectric plant is built, it can continuously convert natural water power into electric power. Its operation does not require a continuing supply of fuel; day-to-day operation requires only expenditures on care and maintenance of the civil engineering installations and generating equipment and the wages of the operating personnel. Accordingly, the cost per kilowatt-hour of electricity generated by hydroelectric power stations is much lower than that for fossil-fired stations. International experience indicates that in all countries or regions where hydroelectric power plays a major role the cost of electricity is rather low. Norway and Canada, which have a high proportion of hydroelectric power, have electricity prices lower than those of other countries. Hydroelectric power in the United States is primarily concentrated in the Tennessee River Valley in the central part of the country and the Columbia River Valley in the northwest; these two areas have lower electricity prices than other parts of the United States. In the past hydroelectic power

accounted for a large percentage of power generation in Japan, but recently, as hydroelectric resources have become nearly fully exploited, it has become necessary to build many fossil-fired plants, so that there has been a considerable rise in electricity prices.

Cheap hydroelectric power generally has a major influence on the economic development of a region, or even a country; its effect on certain industries with large energy consumption is particularly great. Norway's electrochemical and electrometallurgical industries and the nuclear industry in the Tennessee River and Columbia River regions of the United States developed with the support of cheap hydroelectric power.

Because operation of hydroelectric stations consumes no fuel and the number of operating and management personnel is rather small, the cost of production of hydroelectric power is little affected by the increasing commodity prices and wages. The increase in world fuel prices in the last 10 years has led directly to a continuous increase in the cost of fossil-fired power production, but power generation costs in hydroelectric stations have been virtually unaffected by this factor. Once a hydroelectric station has been completed and starts generating power, the cheapness of this power source becomes increasingly clear with the passage of time.

In the capitalist countries, the interest on capital construction investments is an important component of hydroelectric station operating costs. According to our former regulations, no interest was applied to investments, so the cost of producing hydroelectric power in our country was even lower. Currently hydroelectric power production costs in our country are only about a third those of electricity produced in fossil-fired plans. If interest begins to be charged on capital construction investments in the future there will be a rather considerable increase in the cost of producing hydroelectric power, but it is estimated that it will still be cheaper than fossil-fired power. Coal is underpriced in this country at present, and if the prices are readjusted the cost of electricity produced from fossil fuels will inevitably rise. Hydroelectric power is cheap power, and its long-term position will not fluctuate.

F. Hydropower Is Clear Power and Produces Many Advantages From Comprehensive Utilization

Hydropower is the cleanest of the three major conventional primary energy resources and does not pollute air or water, which is a great advantage. Construction of hydroelectric plants does some harm to the environment but also produces some benefits. The greatest questions are inundation of fields by reservoirs, and resettlement of inhabitants, which must be carefully handled in our country with its limited land and large population; everything possible must be done to decrease losses from inundation. At the same time, suitable arrangements should be made for passage of vessels, fish and timber. Insufficient attention was paid to the ecological effects of hydroelectric stations construction in the past, but these matters must now be given sufficient consideration.

Reservoir flow regulation from hydroelectric stations can be coupled with flood prevention, irrigation and water supply; torrents may be converted into lakes, which helps improve navigation; land is converted to water areas, which makes it possible to replace farming by fisheries; and dams can also change scenery and climate and help develop tourism.

G. The Use of Cheap Hydropower Can Promote the Development of Electricity-Consuming Industries

Our country has plentiful reserves of nonferrous and rare metals such as aluminum, magnesium, lead, zinc, copper, vanadium and titanium, and most of the deposits are located in the west and south where there is a good supply of water power. Our country also has plentiful deposits of chemical engineering raw materials such as phosphate, limestone, refining coke and smokeless coal which can be used to produce calcium carbide, synthetic ammonia, sulfur, caustic soda and the like. Production of these materials consumes large amounts of electricity, and their production costs are determined largely by the price of electric power.

The development of hydroelectric power can promote the development of our country's electricity-consuming industries; in the short term it can make it possible to import less of these products and save foreign exchange, while later it will be possible to export these high-priced products and earn foreign exchange, which is equivalent to making these electricity-consuming industrial products into carriers and exporting large quantities of hydroelectric power.

In recent years our country's severe energy shortage has made it impossible for many completed energy-consuming enterprises to operate at full capacity, while some newly developed deposits could not be quickly developed and utilized, so that on the one hand we were exporting energy resources (petroleum and coal) and on the other we were importing electricity-consuming substances, which was equivalent to importing energy.

At international prices, our country's coal exports can earn US $55 per ton of foreign exchange. If electricity from coal is used to refine aluminum, at 20,000 kWh per ton of aluminum and 0.55 kg of coal per kWh of electricity, each ton of aluminum produced is equivalent to consumption of 10 tons of coal or US $550 of foreign exchange. But the price of export aluminum is US $1,200-1,400 per ton, so that it is clearly much more economical to export aluminum than to export coal. If cheap hydroelectric power is used to refine aluminum, production costs will be even lower, so that exporting aluminum to obtain foreign exchange will be even more profitable. Other metals such as titanium and tin are extremely expensive, with prices of US $10,000 per ton or more.

When we export electricity-intensive products, because the output value per unit weight is much higher, the weight of product required to obtain a given amount of foreign exchange is much smaller. For example, exporting a ton of aluminum is equivalent to exporting about 24 tons of coal; this would greatly alleviate the transport pressure on railroads and harbors.

H. Hydroelectric Power's Share of Our Country's Total Energy Consumption Should Be Gradually Increased

In 1980 hydroelectric power accounted for 4 percent of our country's total energy consumption: with an average figure of 413 grams of standard coal per ton of electricity produced in fossil-fired stations, our hydroelectric power output of 58.2 billion kWh is equivalent to 24 million tons of standard coal, which is 4 percent of our total consumption of 602.75 million tons of standard coal. The international computation method differs from this method: the electrical energy produced by hydroelectric power is compared with the thermal energy content of the coal, so that each kilowatt-hour of electricity is equivalent to 120 grams of standard coal. Using this computation method, China's 1980 hydroelectric power output was equivalent to only 7 million tons of standard coal or only 1.2 percent of the total consumption of 586 million tons of standard coal. This figure is lower than the average 1978 worldwide figure of 2.2 percent. Statistics for several countries in 1978 are given in Table 1.

Table 1. Percentage of total electric power output and total energy consumption accounted for by hydroelectric power in various countries (1978)

国 家 a		水电发电量 (亿度) b	水电发电量/总发电量 比重 c	水电发电量的能量/总能量消耗 比重 d
Norway	挪威	810	99.8	40.4
New Zealand	新西兰	166	76.9	16.9
Switzerland	瑞士	325	76.9	14.9
Brazil	巴西	1031	90.6	13.8
Sweden	瑞典	578	62.3	12.8
Portugal	葡萄牙	96	72.7	11.4
Canada	加拿大	2340	69.7	11.2
Austria	奥地利	249	65.4	9.2
Finland	芬兰	134	40.1	6.9
Yugoslavia	南斯拉夫	252	49.2	6.7
Egypt	埃及	92	68.1	6.0
Spain	西班牙	415	41.7	5.9
India	印度	390	36.4	4.2
France	法国	734	33.6	4.1
Venezuela	委内瑞拉	128	52.9	4.0
Italy	意大利	527	30.4	3.6
Mexico	墨西哥	216	40.3	2.9

Key:
a. Country
b. Hydroelectric power output (100 million kWh)
c. Hydroelectric power output/total electric power output
d. Hydroelectric power output/total energy consumption

The percentage of total energy consumption accounted for by hydropower in these countries is much greater than our country's figure of 1.2 percent, in some cases even by a factor of several tens. One reason that is that hydroelectric power accounts for a relatively large proportion of these countries' power industries, and another is that modernization of industry and agriculture and the improvement of the people's standard of living has also raised the share of electric power in total energy consumption. Our country ranks low in both of these respects. In order to make rational use of our country's energy resources, utilization of hydropower should be gradually increased. Currently, in this country hydroelectric power accounts for only 18 percent of total electric power output; it should be possible to raise the figure to 25 percent by the year 2000. This idea is supported by the fact that: (1) many countries have already reached this level, including all of the countries listed in Table 1; in addition, in the 1930's and 1940's hydropower accounted for between 26 and 35 percent of all electric power in the United States, and before 1969 its share in Japan was consistently above 25 percent; (2) we reached the 25 percent figure in 1957, and the figure for 1974-1975 was 24 percent; (3) our country has large untapped hydropower resources; (4) with 30 years' experience, we have already mastered the technology of building large hydroelectric stations of various types; (5) construction of more hydroelectric plants is rational in terms of the long-term development of the national economy.

[No 2, 12 Feb 82 pp 3-5]

[Text] III. China's Water Power Resources and an Evaluation of Them

A. Theoretical ater Power Resources

Our country is immense, with greatly varied topography and considerable precipitation, and its numerous streams contain plentiful hydropower resources. In the 1950's a comprehensive survey put the country's theoretical resources at 540-580 million kW. An even more complete survey made in 1977-1980 indicated that there were 3,019 streams with hydroelectric potential of more than 10,000 kW, and that if some streams with potential of less than 10,000 kW were included the country's theoretical hydropower potential was 680 million kW, equivalent to 5.9 trillion kWh per year.

Hydropower potential is determined by the drop and the runoff of the watercourses. Our country is high in the west and low in the east, dropping gradually from the Qinghai-Tibet Plateau in the west toward the east, while the precipitation gradually declines from southeast to northwest. The drop of streams is large in the western part of the country and runoff is plentiful in the south, producing a nonuniform regional distribution of hydropower resources. Among the large regions, the figure is greatest for the Southwest, accounting for 70 percent of the national total; the Northwest accounts for 12.5 percent, the Central South region for 9.5 percent, East China for 4.4 percent and the Northeast and North China for 1.8 percent each.

2. Developable Hydropower Resources

The theoretical water power resources of streams are determined in terms of their drop and natural runoff. Because of various technical and economic constraints this potential cannot be fully used. The most recent survey also produced statistics on the country's developable water power resources. On the basis of various types of cascade development plans, it was found that 11,103 hydroelectric stations with generating capacities of 500 kW or more could be installed, with a total possible generating capacity of 370 million kW, equivalent to 1.9 trillion kWh/year.

Of all developable water power resources, including completed power stations, stations under construction and those in the survey and design stage or in the advanced planning stage, the total number of power stations with generating capacities of 10,000 kW or more which can be developed is 1,946 (the statistics by category are given on p. 4 of issue No 2, 1981, of this magazine)*. Statistics on the scale of power stations that can be built are given in Table 2.

Hydropower Reserves of China According to Province (Region)

No.	Area, province (region)	Hydropower Reserves: 10,000 kilowatts	Hydropower Reserves: 10 million kilowatt-hours per year	Hydropower Reserves: Percentage of national total
	National	67604.71	59221.8	100
I	North China Region	1229.93	1077.4	1.8
1	Beijing, Tianjin, Hebei	220.84	193.5	0.3
2	Shanxi	511.45	448.0	0.8
3	Nei Monggol	497.64	435.9	0.7
II	Northeast Region	1212.66	1062.3	1.8
4	Liaoning	175.19	153.5	0.3
5	Jilin	297.98	261.0	0.4
6	Heilongjiang	739.49	647.8	1.1
III	East China Region	3004.88	2632.3	4.4
7	Shanghai, Jiangsu	199.10	174.4	0.3
8	Zhejiang	606.00	530.9	0.9
9	Anhui	398.08	348.7	0.6
10	Fujian	1045.91	916.2	1.5
11	Jiangxi	682.03	597.5	1.0
12	Shandong	73.76	64.6	0.1
IV	Central-South Region	6408.03	5613.8	9.5
13	Henan	477.36	418.2	0.7
14	Hubei	1823.13	1597.1	2.7
15	Hunan	1532.45	1342.4	2.3
16	Guangdong	823.60	721.5	1.2
17	Guangxi	1751.83	1534.6	2.6

*Reprinted here from JPRS 78668, CHINA REPORT, ECONOMIC AFFAIRS, No. 157, 4 Aug 81

V	Southwest Region	47331.18	41462.1	70.0
18	Sichuan	15036.78	13172.2	22.2
19	Guizhou	1874.47	1642.0	2.8
20	Yunnan	10364.00	9078.9	15.3
21	Xizang	20055.93	17569.0	29.7
VI	Northwest Region	8417.69	7373.9	12.5
22	Shaanxi	1274.88	1116.8	1.9
23	Gansu	1426.40	1249.5	2.1
24	Qinghai	2153.66	1886.6	3.2
25	Ningxia	207.30	181.6	0.3
26	Xinjiang	3355.45	2939.4	5.0

Table 2. Nationwide developable hydropower resources in terms of scale of development (station generating capacity 10,000 kW or more)

单站装机 a (万千瓦)	电站座数 b	装机容量 c		年发电量 f	
		总数(万千瓦) d	比重 (%) e	总数(亿度) g	比重 (%) h
1—25	$1726+\frac{17}{2}$	7532.18	21.1	3652.33	20.1
25—75	$110+\frac{5}{2}$	4666.97	13.1	2235.41	12.3
75—200	$51+\frac{4}{2}$	6526.67	18.3	3172.36	17.4
>200	33	16981.50	47.5	9123.90	50.2
合 计 i	$1920+\frac{26}{2}$	35707.32	100.0	18184.00	100.0

Note: Installed capacity and annual power output for stations on rivers forming national boundaries are halved, and numbers of stations in such cases are shown as 1/2, 2/2, etc.

Key:
a. Station generating capacity (10,000 kW)
b. Number of stations
c. Generating equipment capacity
d. Total (10,000 kW)
e. Percentage
f. Annual electrical energy output
g. Total (100 million kWh)
h. Percentage
i. Total

In terms of geographical distribution this figure too, like the theoretical hydroelectric capacity, is quite unevenly distributed. The Southeast's developable hydropower resources account for 68 percent of the national total, a large proportion, and are mostly located near the eastern part of that region, relatively close to the electricity-using centers of Sichuan, Yunnan and Guizhou provinces; the transmission distance from Central and East China is not excessively great. In the Northwest, the potential is located primarily on the upper Yellow River, largely in the eastern part of the region, not too far from

the electricity--using centers. In the extensive, sparsely-populated border regions of Tibet, Xinjiang and Inner Mongolia, developable hydropower resources are limited. Distribution statistics are given in Fig. 3.

Table 3. Developable hydropower resources by region (power stations capacities of 500 kW or more)

地 区 a	可能开发水电站 b		电量占全国比重 e
	装机容量 c (万千瓦)	年发电量 d (亿度)	(%)
SW 西 南	23234	13050	67.8
Central South 中 南	6744	2974	15.5
NW 西 北	4194	1905	9.9
East 华 东	1790	688	3.6
NE 东 北	1199	384	2.0
North 华 北	692	232	1.2
Total 合 计	37853	19233	100.0

Key:
a. Region
b. Developable power stations
c. Installed capacity (10,000 kW)
d. Annual electrical energy output (100 million kWh)
e. Percentage of total

The locations in which large power stations of 250,000 kW or more are mostly in the Southwest region. There are also many areas where medium-sized hydroelectric stations with capacities of less than 250,000 kW could be built: there are 213 locations in East China where stations with capacities of 10,000 to 250,000 kW could be built, with a total installable capacity of 8.32 million kW; and there are also many locations in the Northeast.

The uneven distribution of our country's hydropower resources can complement the distribution of coal and petroleum resources. In general terms, the south has considerable water power and the north considerable coal; the interior has considerable water power and the coast has considerable oil. Of the major regions, the Southwest, Central South, North China and Northwest regions have relatively plentiful hydropower resources, while East China and the Northeast are relatively energy-poor.

C. Evaluation of the Regions' Developable Hydropower Resources

1. The Southwest

The hydropower resources of the Southewest are mostly on the Jinsha River, the Yalong River, the Dadu River, the Wu River and the Lancang River.

a. The Jinsha River is the main stream of the Yangtze River above Yibin, with abundant runoff and a large, concentrated drop. The area between Hutiaoxia and the Yibin River has been studied; on the upper section in northern Yunnan and the lower section of the Yunnan-Sichuan border it is estimated that large-scale hydroelectric power stations with a generating capacity of 45.67 million kWh and an annual energy output of 252.1 billion kWh could be built. This river section has the country's greatest concentration of developable water power resources. The cascade of hydroelectric stations on this section of the river would have a certain runoff regulation capability and the inundated area and number of persons displaced would be small. But with the exception of the Xiangjia site in the lower section, all of the sites are located in gorges deep in mountainous territory, the construction locations are cramped and narrow, communications are difficult, and in some cases the foundation cover is thicker, while in other cases earthquake intensity is higher. In addition, the project scale is rather large; it should be scheduled for a relatively late date.

b. The Yalong River is a major tributary of the Jinsha River and is another of the rivers with the country's greatest concentrations of water power resources. The conditions in the project sites are relatively good and are suitable for the construction of high dams, while inundation losses will be rather small. The Ertan and Tongzilin hydroelectric power station sites on the lower reaches of the river are only about 40 km from Dukou city, communications are convenient, and they will be able to supply the large quantities of cheap power needed by the Pazhihua Iron and Steel Company for refining vanadium and titanium, making them ideal sites. These two sites are currently undergoing intensive exploration. There is a large bend in the middle section of the river where a 16-km tunnel could be built, obtaining a head of 300 meters, and in addition a high dam and large reservoir could be built upstream for runoff adjustment and power generation, but present transport conditions are rather poor. These four hydroelectric stations could have an installed capacity of 10 million kW, and in addition to furnishing electric power to the vicinity, there would be a possibility of transmission of the electricity to East China over a distance of about 1,700 km using superhigh-voltage DC lines; there is precedent for this technique abroad.

c. The Dadu River is a major tributary of the Min River with plentiful, steady flow and a large drop. The middle and upper sections are in high mountains and gorges and the engineering geology is generally rather good, but in some cases the cover is relatively thick and the earthquake intensity rather high. Many sites have relatively good communications. Inundation losses from impoundment would be rather small, but the reservoirs would not be large and regulation capabilities would be less than ideal. The Gongju hydroelectric stations has already been built on the lower reaches of this river and the Tongjiezi station is under construction. The cascade planned for the middle section of the river would be 160-240 km from Chengdu, making it a good geographical location.

d. The Wu River is a major tributary of the Yangtze on its southern bank. It is mostly located within Guizhou, but its lower reaches pass through Sichuan before entering the Yangtze. Most of the basement rock is strong, the cover is thin, and there are many sites for dam construction, in addition to which inundation losses will not be great. The main problem is extensive

karstification in limestone regions, making it necessary to plan for leakage prevention in the dams and reservoirs. The Wujiangdu hydroelectric stations has already been built. Projects planned for the near future are the Dongfeng station on the upper section of the river and the Pengshui station on the lower section in Sichuan.

e. The Lancang River is the upper section of the Mekong, the international river of Southeast Asia. It flows through many narrow gorges; the valleys are deeply cut, runoff is plentiful, there are rather good topographic and geological conditions, high dams can be built, and inundation losses will be small. The hydroelectric station cascade planned for the middle section of the river within Yunnan is not far (less than 250 km) from the load centers of Kunming and Dukou and communications are rather convenient. Two sites, Manwan and Xiaowan, are currently being investigated. Construction of the Manwan power station is planned for the near future.

2. Central South Region

a. The Gezhouba hydroelectric station is currently being constructed on the Yangtze. This is a low-head run-of-river station with a very large generating capacity, but in the dry season its output will be small, and because of the navigation constraints the water level must not change rapidly, so that it cannot be used for peak regulation and its generating capabilities will be rather poor. The planned installed capacity of the Sanxia project will be 25 million kW, with an annual energy output of 110 billion kWh, making it a very large scale power station. But the investment and the amount of construction work will be very large, and in particular the fact that 1.4 million persons would have to be resettled in the inundation area makes its implementation difficult. If a low dam is built the generating capacity will be about 6 million kW and the annual energy output 33 billion kWh, while the number of persons displaced can be decreased to 200,000, which is more realistic.

b. The Dongting Lake system in Hunan Province, consisting of the Xiang, Zi, Yuan and Feng rivers, could support many hydroelectric power stations. In general communications and construction conditions are relatively good, and the sites are relatively close to load centers. Conditions for the Zhexi station already built on the Zi River, the Fengtan station already built on the You River, a tributary of the Yuan River, and the Dongjing power station currently under construction on the Dongjiang, a tributary of the Xiang River, among others, are relatively good.

c. The Danjiangkou station and several stations on tributaries have been built on the middle and lower sections of the Han River system in Hubei Province. Development of the Qing River is planned for the near future. Karst problems in limestone regions are relatively complex.

d. The Sanmenxia project has already been built on the lower Yellow River in Henan, and construction of the Xiaolangdi project is planned, but silt is excessive and erosion of hydraulic turbines and engineering installations will be troublesome.

e. In the Pearl River valley of Guangdong and Guangxi, the Dong River has already been largely developed, while the Bei river has fewwater power resources; the main resources are on the Xi River, and the most concentrated resources on the Hongshui River; development conditions are excellent. The topographic and geological conditions on the Hongshui River are good and communications are convenient; conditions are suitable for building a large regulation-type reservoir on the upper section of the river, while the middle and lower sections of the river are suitable for construction of medium and low head hydroelectric stations. Ten cascaded stations can be built on this section of the river (including the Tianshengqiao station on the Nanpan River on the Guangxi-Guizhou border), with a total installed capacity exceeding 10 million kW. The Dahua station is now under construction and preparations are being made to build the Tianshengqiao station, with others to follow. They will be able to supply electricity to Guangxi and Guangdong and develop Guangxi's aluminum refining and other nonferrous metals industries.

3. The Northwest

Developable hydropower resources are most concentrated on the section of the Yellow River between Longyangxia and Qingtongsia. The topography on this section of the river has alternating gorges and open areas and there are many excellent sites. The Longyangxia, Liujiaxia and Heishanxia large-sized reservoirs will be located on the upper, middle and lower parts of this section of the river. They will give relatively good regulation of river flow, and rather thorough river flow utilization, and will provide a reliable supply of power, in addition to which their comprehensive utilization will include flood prevention, irrigation and water supply. The various cascades involve a small volume of construction, and inundation losses will be rather small. Investment per kilowatt will be the smallest of any region of our country.

Four stations, have already been built, at Liujiaxia, Yanguoxia, Bapanxia and Qingtongxia, and are playing a major role in supplying energy to the Northwest. The Longyangxia power station, a multiregulation reservoir on the upper reaches of the river, is under construction, and a construction project below it is being investigated. If the entire cascade of 16 stations were built in this area, they would have an installed capacity of more than 12 million kW. In addition to supplying electricity to the local area, it would be possible to transmit electricity to North China, thus complementing fossil-fired electrical power.

Several large and middle-sized stations could be built on the upper reaches of the Han River in Shaanxi Province; the Shiquan station has already been built. The site has rather good geological conditions. Geological conditions at the site of the Ankang station's dam are rather poor. In addition, there are several other dam sites with average conditions.

4. East China

The main developable hydroelectric stations are in Fujian, Zhejiang and Jiangxi--especially in Fujian. This area has few large-scale power stations; medium and small stations are in the majority. In general, communications and geological conditions are rather good, but inundation problems are considerable.

In addition to a series of large and medium-sized stations which have already been built, the Min River, Ou River and Gan River still await development.

5. The Northeast

Many stations have been built or are under construction: the area is 26 percent developed. The Heilongjiang River, on the Sino-Soviet border, is still to be developed, but development will be difficult in the near term. Other rivers, such as the Gonghua River No 2 and the Yalu River in the south and the Mudan and Lan Rivers in the north, are relatively close to electricity-using centers and communications are rather convenient. But most of the stations will be medium-sized and their costs will be rather high. But they are worth developing in the energy-poor northeast.

6. North China

The middle section of the Yellow River passes through the Shaanxi-Shanxi border region. This area's geographic position is rather central, but the quantity of water is small, there is much silt, and certain large power stations (such as the Longmen station) involve a large quantity of construction and many problems.

The Hai-Luan valley's developable water power resources are located primarily in the gorges of tributaries such as the Luan River, Yongding River, and Bai River, where some generating stations could be developed; these are close to electricity-using centers, but the scale of the stations would be rather small.

[No 3, 12 Mar 82 pp 3-6]

[Article by the Science and Technology Committee of the Ministry of Electric Power: "The Role of Hydropower In Our Nation's Energy Resources and Its Development Policy"]

[Text] IV. Planning of Hydroelectric Power Construction and Measures to Hasten Construction

(I) Principles of Planning Hydroelectric Power Construction

1. Construct large, medium and small projects simultaneously, use large projects as the backbone, build a group of medium hydroelectric power stations in the near future. According to the characteristics of hydroenergy resources, the hydroenergy resources of large, medium and small rivers must all be developed. Therefore, large, medium and small projects must be simultaneously built. Because the demand for developing electric power is large and because our nation has more large hydroelectric sites, therefore, we should use large hydroelectric power stations as backbone projects. In the past, large hydroelectric power stations were managed by the Central authority, small hydroelectric power stations were managed by the localities, and there was less development of medium sized hydroelectric power stations. With only a few projects begun during the previous period, the hydroelectric capacity to be added to production in the next 4 to 5 years is less, therefore, a group of

medium hydroelectric power stations must be built. Although the construction cost per unit kilowatt of the medium sized hydroelectric power station is higher, the required investment is less, the construction period is shorter and the stations can produce relatively quick results.

2. Power stations regulated by a reservoir and runoff power stations must be built simultaneously. The variation in the amount of water flow during flooding and drought in many of our nation's rivers is large. We must build reservoirs to regulate runoff before we can better utilize natural hydroenergy resources and supply the needs of the electric power system. But, our nation has more people and less land. When we build reservoirs, we often encounter the difficult problems of flooding arable land and moving people. Under this situation, we can only build low waterhead runoff power stations or diversion runoff power stations. Power stations regulated by reservoirs and runoff power stations can be combined to supply electricity to the electric power system.

3. Build large reservoirs in the upper reaches of rivers where there are less people, and build low waterhead step power stations in the lower reaches where the population is concentrated. In this way, we can reduce the loss by flooding from the reservoir and the reservoirs at the upper reaches can regulate runoff. This will benefit the series of step power stations at the lower reaches.

4. More hydroelectric power stations should be built in the southwest, the south central and the northwest regions where hydroenergy resources are rich.

5. In North China and the northeast where energy resources are lacking, hydroenergy resources that have not been developed should be actively developed, and consideration must also be given to expanding hydroelectric power stations that have already been built and to building pumped storage power stations. The North China region must also consider building pumped storage power stations to regulate peak generation.

(II) The tentative schedule for expanding hydroelectric power projects at each locality before the year 2000

To actively utilize our nation's rich, regenerative and cheap and clean hydroenergy resources so that our nation's present low proportion of hydroelectricity can be increased in our considerations of all possible conditions for developing hydroelectric power stations, for surveying, designing, scientific research and construction, our preliminary estimate is that between 1980 and the year 2000, we can add 40 million to 50 million kilowatts of installed capacity and 1,500 billion to 1,900 billion kilowatt-hours of hydroelectric output a year. By that time, the proportion of hydroelectric power output can be increased from the present 18 percent to about 25 percent.

The tentative estimates of the increase in hydroelectric power capacity for each five-year plan except 1981-1985 which have already been established are as follows:

1981 - 1985	To add 4 million kilowatts
1986 - 1990	To add 9 million to 10 million kilowatts
1991 - 1995	To add 12 million to 16 million kilowatts
1996 - 2000	To add 15 million to 20 million kilowatts
1981 - 2000 total	To add 40 million to 50 million kilowatts

(III) Sources of Capital and Related Policies

To realize the above tentative plan, the source of capital is a major problem which must be solved by many methods. Preliminary consideration includes the following ways:

1. Besides investment by the electric power industry in regenerative energy resources including hydroelectricity, the state should allocate special funds as a special investment in hydroelectricity. Like coal mines and oil fields, this investment should be an investment in exhaustible energy resources so that efforts can be centralized to develop hydroelectric power.

2. Bank loans should be made available. Hydroelectricity, coal and petroleum should be the same. The annual interest rate should be lowered from the present 3 percent to 2.4 percent. Because the life of a hydroelectric power station is long, foreign nations generally set 50 years as the number of years for return on investment capital. Our nation presently limits this period to 15 years. It is too short and it should be extended.

3. We must actively utilize favorable foreign long term, low interest loans. All foreign nations that are willing to provide loans for our nation's hydroelectricity buildup are welcomed. Their loans should be converted according to international market exchange rates into renminbi, and taxes and fees should be reduced as much as possible before hydroelectricity buildup can be stimulated.

4. Mobilize local funds. These should be combined with funds provided by the Central authorities to build hydroelectric power stations. Compensation for flooding by reservoirs can be borne by the localities as a part of investment in hydroelectric power stations. After the power stations have been built, profits from the sale of electric power should be shared proportionally according to investment and special privileges in the use of electricity should be given.

5. Investments in comprehensive utilization projects should be shared so that other beneficiary departments can share part of the investment for construction.

6. The investment in oil conservation and energy conservation to be realized by substituting hydroenergy for oil fuel should be utilized for hydroelectric power construction.

7. Bonds for hydroelectricity construction should be floated to absorb floating capital of localities, groups, units or individuals and overseas residents to develop hydroelectric power construction.

(IV) Preliminary Work in Planning, Surveying, Designing, and Scientific Research Must Be Done Well

To guarantee rationality in selecting the sites for building hydroelectric power stations, planning work is very important. This includes plans for rivers, regional plans and plans for electric power systems.

Plans for rivers (or river sections) must start out from the principles of rational and comprehensive utilization of hydroenergy resources and they must be compared so that development can be carried out in stages. Near-term projects should be drawn up from this. The scope of the plans for rivers can include one river or one river section, but the relationship between the development of the trunk river and branch rivers of the whole river valley must be considered and explained.

Proposed regional plans which include several rivers or river sections within a region should prove the rationality of the river selected for development and the rationality of the project to develop electric power in the region.

Plans for electric power systems must include hydroelectric power stations already built and hydroelectric power stations proposed. Consideration must also be given to thermal power stations that have already been built and those planned to provide a unified and balanced supply of electricity. The plans must also include a unified layout for the transmission network. From this, the rationality of the proposed projects and the scale of the power stations can be determined.

When proposing designs for planned projects, we must first review the above documents, the designs and the plans together. But, plans are not unchangeable. They should change according to the situation and they should be revised when selecting the next phase of construction.

Surveying work must be hastened under the prerequisite of assuring quality. Activities must follow the procedure in capital construction, and work can begin only after the preliminary design has been approved. Preparations for construction can be done first after dam site selection reports or feasibility reports have been reviewed and approved to allow time for construction. Preparations for construction carried out when the proposed project is being planned and when the dam site has been determined will not be wasted efforts and rebuilding will not be required. It is better to use reports of feasibility studies than dam site selection reports because their content includes technical arguments and more economic arguments related to the project's rationality and provides more references for the higher authorities in reviewing and approving plans.

Scientific research must serve planning, surveying, designing and construction. It should promote the use of new techniques, new technologies, new materials and new methods so that the speed of construction of hydroelectric projects and the construction cost can be lowered.

(V) Implement the Economic Responsibility System, Hasten Progress in Construction, Guarantee Construction Quality

In the past, some large hydroelectric power stations took 3 to 5 years from groundbreaking to the beginning of power generation. Recently, this period has extended to 8 to 10 years. Besides such objective factors as complex geological conditions and difficulties in construction, the main factors are poor management and low work efficiency. The long construction period cannot satisfy the demands for electricity in time. It also accumulates state investment and delays the time of recovering the investment. To hasten progress in construction, organization of construction teams must be hastened. The level of management must be improved. New forces must be trained. Mechanization of construction must be improved so that the front line can have a skilled and highly efficient combat team.

We must change the present situation of "eating from the big pot" and the low work efficiency and we must implement the economic responsibility system. We must start a limited number of projects at a time and give small contracts to teams and groups, establish job quotas, quality standards, quotas, progress schedules, systems for delivery and inspection and methods of reward and punishment. Later, we must further expand these to include a portion of actual construction, investment management, contracts of whole projects and a management responsibility system so that the unit in charge of the project is responsible for its own profit and loss.

V. Several Technical and Economic Policies

The following suggestions regarding technical and economic policies in hydroelectric power construction have been proposed:

(I) Comprehensive Utilization and Sharing of Investment

The development of hydroelectric power must adhere to the principle of comprehensive utilization of hydroenergy resources. Besides using hydroenergy for the generation of electricity, we should also consider the gains of comprehensive utilization in flood prevention, irrigation, water supply for cities and industries, navigation, log transport, aquatic production and tourism together. Some river segments can be comprehensively utilized by many sectors while other river sections can be comprehensively utilized by fewer sectors.

When building hydroelectric stations, the original benefits from the utilization of the river by each sector should be retained. For example, the original gain in irrigation, ability of navigation, fish passage and log passage should all be retained. When damage occurs, it should be remedied. Each sector involved in comprehensive utilization must provide newly added gains and it should consider their rationality. Each sector must seek the most economical

and rational plan by comparing various plans. Long range goals can be gradually realized to avoid an accumulation of capital. If the requirements proposed by each sector are too lofty, or if they are demands that span an overly long period, total investment in the project will be very large. This is not economically rational, or sometimes the project simply cannot be built. These are all unfavorable to the sector that needs hydroelectric power. The general goal of projects for comprehensive utilization should require the least amount of total investment by the state and product maximum comprehensive gain for the national economy.

Investment in projects for comprehensive utilization must be shared among the sectors that will reap benefits. The method of sharing investment can be determined by the actual situation, for example, the method of sharing costs and surplus gains.

(II) Reduce Loss From Flooding By the Reservoir and Provide Rational Compensation

Our nation has less land and more people. The problems in moving residents when building reservoirs and the problems due to flooding of agricultural land, mines, factories, houses, railroads, highways, forests, ancient ruins are outstanding. These are not only economic problems, they also involve social problems or political problems. Sometimes, they affect the possibility of construction. In river planning and engineering designs, we must consider reducing the loss due to flooding by the reservoir as much as possible. In densely populated and industrially and agriculturally developed regions, reservoirs should not be built whenever possible or development should be carried out in phases as much as possible. In regions of the upper reaches of rivers where there are few people, even though the technology of building high dams is more complex and the amount of construction is much larger, we must still build large flood blocking dams to regulate runoff so as to reduce the loss in flooding by the reservoir. The gain and loss must be measured in light of the whole national economy.

Areas flooded by reservoirs must have protective measures to reduce loss in flooding, such as dykes, drainage facilities, etc. When the reservoir area is changed from a land surface to a water surface, agricultural production can be changed to fishery production, and this change should be considered in moving the population. In moving the population to make way for the reservoir, we must implement the principle that the level of production and living standards of the population after being moved are not lower than the original level and standard. Plans for the resettlement of the population must be done well and arranged well and there must not be any problems remaining. The criteria for monetary compensation for moving, land acquisition and compensation for loss due to flooding must be rationally regulated and implemented after approval by the State Council. Funds for moving and compensation for loss due to flooding can be borne by local governments on the basis of calculations made according to the criteria approved by the State Council and such should be included as part of the shared investment in the hydroelectric power stations to be built. After the hydroelectric power stations begin generating electricity, the benefits which would be received in proportion to

the investment should be distributed accordingly. After the population of the reservoir area has been resettled and after the land has been acquired, the rights to manage the land and water surfaces within the area should belong to the hydroelectric power station. Cultivated land near the reservoir can be used for planting before the reservoir stores water, but houses and buildings should not be built. When the reservoir stores water, all crops and buildings that are flooded will not be compensated for.

(III) Standards in Designing Hydroelectric Power Stations and Rules and Regulations

The rules and regulations concerning hydroelectric power construction should reflect the advanced levels, and at the same time they should include our nation's actual situation. The purpose is to achieve quick and economical results under the prerequisite of guaranteeing the quality of our nation's hydroelectric power construction.

The following problems should be noted:

1. The criteria for the amount of flood water allowed in the design of large dams (including inspection and protection of the dam) must not be changed back and forth as was done in the past. Safety of the large dam must be considered to avoid serious loss of life and property in case an accident occurs, and the rationality of the criteria for the design must also be considered. When calculating the amount of flood water, the worst situation must not be considered in every step and added to every step. Calculating an overly large amount of flood water in the design (including inspection and protection of the dam) will make it difficult to draw up engineering plans. The cost will be too high and the construction period will too long. This is not rational.

2. The criteria for earthquake resistance of large dams should be appropriately established when considering the safety of large dams.

3. We should consider the complex geological conditions at many of our nation's dam sites, the difficulty in the supply of cement (the difference between the current price of cement and the value), and the great progress that has been made in the design and construction techniques of earth and rock dams and tunnels at present. In selecting the type of dams, we must give more consideration to the rationality of dams built from local materials.

4. When determining installed capacity, we must start out from the need of the power system and establish technical and economical rationality. When establishing duplicate capacity, we must consider seasonal users or the possibility of replacing coal by thermal power within the system. Consideration must be given to the future development of the power system. We must provide leeway for expansion.

(IV) Rationally Adjust the Price of Electricity According to the Characteristics of Hydroelectricity

Because hydroelectric power stations are characterized by the ability to regulate the water stored in the reservoir and the ability of versatile and rapid start up of their generators, they provide electricity to the system and they also serve the function of regulating peaks, regulating frequency and as a reserve power source in case regular generators breakdown. In pricing electricity, prices for peaks and troughs should be separated to reflect the overall function of hydroelectricity. If hydroelectricity is not used for regulating peaks, regulating frequency and as a reserve when generators breakdown, the cost of generating electricity by thermal transformer generators of fuel fired steam turbines will be higher. When building pumped storage power stations, prices for peaks and troughs must be separated before their economic rationality can be proven.

The normal amount of electric power provided by hydroelectric power stations and seasonal electric power should be priced differently. This is beneficial to rationally determining the installed capacity, it is beneficial to attracting seasonal users to fully utilize seasonal electricity, and it is beneficial to both the power station and the users.

Because the cost of generating hydroelectricity is low, the prices of electricity in regions where the proportion of hydroelectricity is larger should be lower than the price of electricity in regions where the proportion of thermal electricity is larger. This is beneficial to attracting industries which consume a large amount of electricity (such as nonferrous metals smelting industries and heavy chemical industries) to establish their plants in regions where hydroenergy resources are rich. It is also beneficial to the appropriate distribution of industry and resources, and it reduces the investment in and the pressure on massive transportation of coal and power transmission.

The various types of price readjustments described above can be made rational by adjusting the price lower or higher at different localities while the total average price of electricity throughout the nation remains basically unchanged.

(V) Sharing the Gain Between the Regions Where Hydroelectric Power Stations Are Located and The Regions to Which Electricity is Supplied and Between the Upper and Lower Reaches

As the power system develops, more and more hydroelectric power stations are transmitting electricity from one province and region to another province and region. According to the present system, taxes on the sale of electricity are all collected by the region selling electricity. The locality where the power station is located does not collect such tax. This is not rational. To rationally solve the problem of the economic benefit of the regions generating electricity and selling electricity, the tax policy on electricity must be adjusted and changed so that taxes can be levied on the generation of electricity and the sale of electricity. For example, the former can collect 60 percent and the latter can collect 40 percent so that the enthusiasm of the regions with rich hydroenergy resources can be mobilized to build hydroelectric power stations and to transmit electricity.

Building reservoirs at the upper reaches of rivers to regulate runoff benefits the series of step hydroelectric power stations along the lower reaches to increase guaranteed output and the amount of electricity generated. When conducting economic analysis and studying plans to share the gain, the increased gain should be rationally divided between the upper and the lower reaches, such as 50 percent each.

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1981 HYDROELECTRIC POWER OUTPUT REACHED 63.8 BILLION KWH

Beijing SHUILI FADIAN [WATER POWER] in Chinese No 2, 12 Feb 82 p 24

[Article: "Nationwide Hydroelectric Power Generation in 1981 Reaches 63.8 Billion KWh, 27.6 Percent Above Plan"]

[Text] Nationwide hydroelectric power output in 1981 was 63.8 billion kWh, which was 13.8 billion kWh or 27.6 percent above plan. The figure was 5.6 billion kWh higher than the 1980 output. This was the best hydroelectric power generation year in our history and marks a new improvement in our country's hydroelectric power operations management. The 63.8 billion kWh accounts for 20.9 percent of our country's total electrical energy output and replaces the equivalent of 38.26 million tons of coal. This has made a major contribution to decreasing consumption of coal and oil resources.

Following improvements in 1979 and 1980, in 1981 the power grid management offices, provincial power offices and hydroelectric plants further strengthened their operations management, making a major effort in economic dispatching, and while assuring project safety in the flood season, they strove hard to store more water and generate more electricity. In the water supply period they persistently adhered to the power generation plan and strictly controlled reservoir levels. At the same time, they devoted attention to better prediction of reservoir hydrology and weather forecasting, constantly adjusted their plans in accordance with actual river flow and strove to maintain rational operation of the station reservoirs, with the result that increased quantities of electricity were generated and better use was made of the stations' advantages in frequency and peak adjustment and their emergency backup function. Ten large hydroelectric stations, namely the Fengman, Shuifeng, Yunfeng, Hunjiang Cascade, Xin'anjiang, Zhexi, Gongju, Xinfengjiang, Liujiaxia and Mudankou stations, produced a year's total of 23.6 billion kWh, up 4 billion kWh from 1980, with an average water consumption per kWh that was 23.5 percent less than in 1980, an indication of further improvement of operating management. Because of timely equipment overhaul, during the flood season the Fengman hydroelectric plant managed to operate safely while generating large quantities of electricity. In June and July alone it decreased the amount of water flow by 2.55 million cubic meters and generated an additional 278 million kWh. Learning a lesson from insufficient agricultural irrigation water and limited electric power in the grid, the northwestern power grid made

further rational adjustments in dispatching at the Liujiaxia reservoir, did everything possible to generate more fossil-fired electricity and controlled hydroelectric power generation in the period before the agriculturation irrigation period, then generated more electricity during the irrigation period, thus allowing more land to be watered while producing increased quantities of electricity and providing better integrated utilization at the Liujiaxia station. Because the Hunan power grid undertook group compensatory operation of hydropower stations and priority dispatching, the Zhexi power station generated a total of 2.4 billion kWh for the year, a new record.

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TWO NEW HYDROELECTRIC POWER UNITS ORGANIZED

Beijing SHUILI FADIAN [WATER POWER] in Chinese No 1, 12 Jan 82 p 37

[Article: "Construction Committee of China Hydroelectric Power Engineering Society and Hydroelectric Engineering Society of PLA Capital Construction Forces Organized"]

[Text] On 14-18 October 1981 the China Hydroelectric Power Engineering Society held a meeting of the Construction Mechanization and Construction Management Committee (referred to for simplicity as the Construction Committee) in Panjiakou, along with the inaugural meeting with the Hydroelectric Power Engineering Society of the PLA Capital Construction Forces.

Director of the Hydroelectric Engineering Society Prof Shi Jiayang [2457 0857 3568] and deputy directors Deputy Minister Li Eding [2621 5501 7844] and Deputy Chairman Shen Xinxiang [3088 0207 4382] attended the meeting and made speeches. The meeting was attended by 122 persons including engineering and technical personnel, scientific research personnel and professors involved in hydroelectric construction, site surveying, design, machinery manufacture and education. The Construction Committee of the Water Conservancy Society and the Headquarters of the Capital Construction Forces also sent representatives to the meetings.

At the meeting 52 persons, including Li Eding, were elected to the Construction Committee. At the first plenary meeting of the committee Wu Shide [0702 1597 1795], He Yi [6320 3015], Li Jinghang [2621 2529 3100], Tan Jingyi [6223 7231 1138], Wang Shengpei [3769 5110 1014], Guan Yingjun [7070 5391 0193] and Han Moning [7281 2875 1380] were elected chairmen and vice chairmen. In order to initiate special activities and thoroughly enlist the members' activism, it was decided to create six specialized working groups on construction management, concrete engineering, underground engineering, defects in large dams and foundation treatment, construction machinery, and water diversion during construction; the Minjiang River Engineering Office, Offices Nos 3 and 4, Unit No 00639, the Hangzhou Research Institute of Machine Design and the East China Institute of Site Surveying and Design were made responsible for chairmanship of the groups and development of experience-exchange on the topics in question.

The Hydroelectric Engineering Society of the PLA Capital Construction Forces elected a 42-member executive committee and chose Prof Shi Jiayang as honorary director and Cui Jun [1508 7786] and others as director and deputy directors. During the meeting, technical experience was exchanged and 21 papers on specialized topics in concrete construction, large dam and foundation treatment, construction machinery, new materials and the like were discussed. Many of them were at a relatively high level and were welcomed by the representatives. In addition, three specialized technical reports dealing with investigations of construction abroad were heard.

The meeting made a summation and announced the formal establishment of the Construction Committee and of the Hydroelectric Engineering Committee of the PLA Capital Construction Forces.

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CSO: 4013/7

CONFERENCE FOCUSES ON QUALITY CONTROL, MANAGEMENT OF HYDROPOWER

Beijing SHUILI FADIAN [WATER POWER] in Chinese, No 12, 12 Dec 81 pp 4-8, 25

[Article: "Notes on the Conference on Preliminary Work for Hydroelectric Power Projects and Construction Quality Control, 21 September 1981"]

[Text] The General Bureau of Hydroelectric Power Construction held a conference on preliminary work for hydroelectric power projects and construction quality control in Beijing from 8 to 21 September 1981. Attending the conference were delegates from various hydroelectric power bureaus subordinate to the Ministry of Water Conservancy, design institutes of the ministry, related hydroelectric power bureaus, construction command headquarters, design institutes of related provinces (autonomous regions), the State Planning Commission, the State Capital Construction Commission, the Energy Commission, Hydrological Sciences Academy, the 330 Engineering Bureau, and the hydroelectric power command headquarters of the Capital Construction Engineer Corps. The related departments and bureaus of the Ministry of Water Conservancy also sent delegates to attend the conference. The Changjiang Administrative Office and the Beijing Design Institute of the Ministry of Water Conservancy were invited to attend. The conference was attended by a total of 191 delegates.

The main task of this conference was to summarize the lessons and experience in hydroelectric power construction since the founding of the nation under the guidance of the spirit of the Sixth Plenum of the 11th Party Congress, further purge "leftist" influence, overcome the weaknesses and laziness in ideological leadership, study methods and measures to hasten preliminary work for hydroelectric power projects, improve quality of construction, implement the economic responsibility system, and strive towards changing the passive situation in hydroelectric power buildup within 3 years.

In the opening session of the conference, delegates learned the important talks and speeches by comrades Deng Xiaoping and Hu Yaobang concerning problems in the ideological battlefront and the opinions concerning economic work expressed by comrade Zhao Ziyang.

During the conference, Comrade Li Rui [2621 6904] made two important speeches. Comrade Wang Ganguo [3769 1626 0948] gave a speech summarizing the documents presented for discussion at the conference by the General Bureau of

Hydroelectric Power Construction. Comrades Qian Sichao [6929 2646 3390] and Jiang Zhaozu [5592 0340 4371] of the State Planning Commission and Comrade Yuan Lian [5913 5114] of the Production Department of the Ministry of Water Conservancy presented the hopes and demands on how to hasten preliminary work for hydroelectric power projects and how to improve the quality of construction of power stations.

After learning and discussion, comrades attenting the conference unanimously believed that the guiding ideology of this conference was clear. They believed that the conference proposed the goals for struggle and studied concrete measures, and that the conference will actively stimulate and hasten hydroelectric power construction.

I.

Since the founding of the nation, hydroelectric power construction has realized great achievements. We have understood the hydroenergy resources of the whole nation. We carried out a lot of work in planning, surveying, designing, and we built many large and medium sized hydroelectric power projects. We have contributed greatly to our nation's socialist construction. Through practice, we trained hydroelectric power construction teams that can do difficult tasks. The technical standards, technical equipment and capabilities of this team have been greatly elevated. At present, we can rely on our own strength to independently and actively build various large and medium sized hydroelectric power stations.

Over the past 30 years, there have been successful experiences and lessons from failures in hydroelectric power construction. Everyone believed that there must be a strong leading group to summarize the experience of these 30 years and to build hydroelectric power projects well. We must cultivate a team of workers who are advanced in ideology, technically skilled, and well disciplined. We must establish a plan for hydroelectric power construction which suits the situation of our nation and which seeks truth from facts. We must respect science and strictly obey the order in capital construction. We must fully develop the function of technical experts. We must insist on the policy that quality is foremost. We must implement scientific business management. We must study technical and economic policies and pay attention to economic results.

The main lesson in hydroelectric power construction over the past 30 years has been the influence of "leftist" ideology, which included efforts that were detached from reality, the use of politics as a substitute for technology, the use of subjectivism as a substitute for science, violation of the order of capital construction, neglect of the quality of construction, and relaxation of business management. Everyone agrees that we should conscientiously summarize the experience and the lessons, continue to purge the influence of "leftist" ideology, and we must not repeat our mistakes of the past.

Since the Third Plenum of the Party, each unit has made a series of efforts to bring order out of chaos. The leading groups were reorganized. The policies governing cadres were implemented. Many unjust, false and mistaken cases

were overturned, and business management was preliminarily reorganized. All the efforts of the units realized definite progress. At present, the overall situation in the hydroelectric power frontline is good.

But because of serious destruction during the 10 years of civil upheaval, and with the shortcomings and mistakes in our leadership, the passive situation in hydroelectric power construction has not been fundamentally turned around. Preliminary work still lags behind the needs in construction. There are still many problems in the quality of construction. Business management is still relatively backward. The "leftist" influence has still not been conscientiously purged. The leading groups at each level still have to be reorganized and further strengthened. There are still many problems in building up manpower teams. In particular, laziness and weaknesses in ideological leadership are the major barriers to progress in present work. Comrades attending the conference indicated that these problems must attract a lot of attention and emphasis and they must be concretely solved.

Based on the nation's demands for hydroelectric power and the present situation in hydroelectric power construction, the conference proposed that we must lift up our spirit, strengthen our enthusiasm in work, and strive to change the passive situation in hydroelectric power construction within 3 years so that the need for hastening hydroelectric power buildup can be satisfied.

(1) We must establish a leading group that firmly believes in the four basic principles, that has an upright Party character, that can unite and fight, that is skillful and forceful, that is young and strong, that understands production technology, and that is capable of business management according to the requirements of the four modernizations.

(2) We must hasten the pace of preliminary work. We must draw up five-year plans and long-range plans well. We must strengthen economic analysis and proof. We must improve the quality of surveying and designs. We must make sure that the designs of the projects being built and projects to be built are not changed. We must prepare a number of projects which can be started for the "Sixth Five-Year Plan" and the "Seventh Five-Year Plan."

(3) The quality of construction must be improved and elevated by a relatively large extent. We must carry out construction strictly according to the requirements of the designs and quality standards. We must gradually implement overall quality control. After the projects have been completed, they must be safe, they must be economical, they must generate power at full capacity, they must form a complete productive capability, and they must develop economic gain to the maximum limit.

(4) Business management of enterprises must be concretely improved and strengthened. We must actively implement the economic responsibility system and make sound the responsibility systems at each level. We must perform the fundamental tasks of business management well. We must establish a set of relatively complete system of rules and regulations. We must implement scientific management and civilized construction.

(5) The political ideology, technical standards and job capabilities of the workers must be improved by a relatively large degree. We must gradually build a team of workers in hydroelectric power construction who have a high consciousness, who are technically skilled, who are well disciplined, and who have a good work style.

(6) The building of the four design institutes in Eastern China, South Central China, the Northwest and North China must be basically completed. Establishment of surveying and construction teams must have a definite initial scale. On the foundations of developing production, collective welfare and material and cultural life of workers must be improved.

The conference asked that each unit propose its own goals of struggle according to the above spirit and by combining such efforts with the actual situation in the units themselves. Workers and masses must be mobilized to exert efforts to organize and realize the above.

II.

Doing preliminary work well is the foundation for hastening hydroelectric power construction. To enable preliminary work to progress first, comrades attending the conference unanimously believed that during the present period of readjustment, we must concretely do the following tasks well.

(1) We Must Strengthen Surveying Work To Make Sure That the Basic Data Are Reliable

The special hydrological measuring stations of the hydroelectric system have been streamlined many times and the present strength is very weak. Each academy must establish and make sound the organizations and agencies of hydrological surveying, strengthen management of measuring stations, and improve the means of surveying. Each academy should also gradually establish additional special hydrological and meteorological observation stations according to the duties performed.

Surveying for the hydroelectric system is also very weak. Each academy must carry out necessary renovation of equipment and establish navigational surveying centers.

Geological surveying work must insist on scientific procedures and be carried out from the general to the specific. The general and the specific must be combined. Drawings must be made first and then surveying can be done in an appropriate order and progress gradually. We must strengthen geological analysis and geology must be combined with designing to guide surveying. All means of surveying must achieve the purpose of producing a geological report that clearly investigates geological problems and improves quality to prevent blind surveying. We must be skilled at comprehensively utilizing various means of surveying, renovate instruments and facilities, and we must especially strengthen equipment for physical exploration and experimentation according to plan. We want to strive towards basically realizing small caliber diamond bit drilling by 1983.

At present, surveying agencies consist of two managerial systems, the headquarters team and the department. Each academy can study and summarize this further according to the actual situation. To suit necessary surveying work during the planning stage, small surveying squadrons with versatile, portable and advanced equipment and well deployed and skilled personnel should be organized and established.

(2) We Must Strengthen Planning Work and Distribute Hydroelectric Projects Well

Each academy must have good plans for the rivers (river sections) according to current plans for the major rivers within the regions of the various jurisdictions so that rational and feasible plans for rivers which can be developed in the near term or within 3 years can be presented. Comprehensive utilization must be carried out well and attention must be paid to stepped development. The problem of flooding by reservoirs must be considered very carefully. Chief project engineers (chief design engineers) should be established as the situation warrants in drawing up plans for major rivers. It is suggested that concerned leading departments should organize reviews for approving reports on river plans.

We must strengthen the work in planning power systems. We must conduct studies in estimating the load and the function of the hydroelectric power sources in the system. Each academy should restore and strengthen systems planning agencies and participate in the work of planning their region's power system. It is suggested that the ministry establish a systems planning agency with the participation of the hydroelectric power bureau. Economic analysis and the study of ecological balance and environmental protection must be done by specialized personnel. Economic analysis must be strengthened and investigation and research must be strengthened.

We must develop the work of selecting sites for regional hydroelectric power. We must draw up ten-year and twenty-year regional hydroelectric power plans. While designing necessary large backbone engineering projects, we must select a number of medium sized engineering projects that have favorable conditions for development in the near future and propose designs for them. The design institutes should be included in the leading groups for planning electric power in their own regions (power network).

(3) We Must Guarantee That the Design of the Project in Construction Is Not Changed, and We Must satisfy the Construction Needs

Each institute must place the finalized designs of projects currently in construction in the foremost position. Necessary forces must be provided according to the needs of each stage of construction to submit blueprints and documents required by the construction 3 to 6 months ahead of time. At present, the institutes must sign agreements with construction units to submit the designs on time. At the same time, organization, construction designs and the work of estimating the budget must be strengthened. Estimated budgets of construction projects that still do not have estimated budgets must be estimated and reported by the design institutes. The estimated budgets of

construction projects whose estimates have already been reviewed and approved must also be double checked according to the requirements of the general bureau.

Projects that have begun must strengthen and make sound the design institute's representative group stationed at the construction site. The designing sector and the construction sector must unite and cooperate with each other and provide mutual assistance.

(4) We Must Strengthen Scientific Research and Experimentation and Basic Technical Work, and We Must Continue To Improve Technical Standards

First, we must improve the capability of productive experiments, including rebuilding the institutes. The important component sectors developed by each of the scientific research institutes of the academy to carry out the work of the academy must be gradually strengthened to strive towards basically taking over the tasks of the academy within 3 years. At the same time, the tasks and characteristics of the academy must be combined to conscientiously compile five-year and ten-year scientific research plans so that the development of scientific research of each institute can be realized by division of labor and with emphasis, and we must gradually establish several scientific research and experimental centers with unique characteristics. Such specializations as hydrology, geology, planning and machinery and electrical work must study special topics according to approved scientific research plans. The technical departments must be placed under the jurisdiction of each specialization in the institute and the tasks of scientific research and experiment, related plans and funds should be separately included in the proper channels and in the annual production plan of the institute for the institute to compile, report and manage uniformly.

The major technical topics present in current production such as dynamic economic analysis, the study of the stability of large dams on complex foundations, the study of the stability of tall earth and rock slopes on the sides, the study of the stability of the walls of underground tunnels, the study of the prevention of erosion and washing by a large flow of water at high speed must be organized and we must cooperate with each other to strive towards making breakthroughs as soon as possible.

Attention must be paid to fundamental technical work. The buildup of various tasks such as establishing limits, collecting construction blueprints, summarizing technology, publishing design handbooks, gathering technical information, making specified measurements, establishing technical files must be included in the production plans. Forces must be organized, data must be accumulated, and these must be continually perfected.

(5) We Must Make the Technical Responsibility System Sound, and We Must Guarantee the Quality of Surveying and Designing

We must clearly understand and divide the technical responsibilities of the general bureau and each design institute and fully develop the duties and rights of each institute. The general bureau is in charge of preliminary design and review of the major principles of the previous stage, such as the guiding

ideology in planning and design, selection of major technical and economic goals and distribution plans, conclusions on major technical and economic measures, and the general bureau must provide help and coordinate important external relations. All other matters except those under special regulations should be the responsibility of the design institutes.

The general bureau and each institute must pay attention to summarizing experience and study technical and economic policies related to the development of hydroelectric power, such as compensation for moving residents, pricing hydroelectricity, transmitting electricity generated in the west to the east, nonferrous metallic joints for hydroelectricity, so that concrete measures and legislative opinions can be proposed and submitted to higher authorities for review and approval.

We must further make sound the technical responsibility systems at each level within the institute. The chief engineer, the chief design engineer, the head engineer must have duties, authority, responsibility. The responsibility of the chief design engineer must be strengthened so that his responsibilities will serve to coordinate production between specialized sectors and supervising technology.

Each specialized department in planning, surveying and designing must grasp the working plan and the technical guidelines well. It must conscientiously carry out regulations, implement the system of review and evaluation at each level, and perform quality evaluation work well. Quality must be the main indicator to measure whether a plan is completed or not. Those projects that do not pass quality evaluation cannot be considered to have completed the plans and such evaluation must be combined with rewards and punishment.

III.

The quality in building, installation and construction of hydroelectric power stations not only involves safety, full capacity generation, economic operation as required by the design of a power station, it also is related to the safety of people, life and property. Therefore, high standard and strict requirements must be insisted upon to seek fast results in good quality and to seek conservation in good quality. The policy calling for "plans to last for 100 years and quality to be foremost" must be implemented. Comrades attending the conference believed the following tasks urgently need to be done well at present.

(1) Strictly Abide by the Order of Capital Construction

The leadership at each level must respect science, insist on seeking truth from facts, and do things according to objective rules. Engineering construction must strictly abide by the order in capital construction and normal construction procedures. Main construction must not begin if necessary preparation for construction has not been completed. Unit construction (or separate stages and separate projects) that does not have planned construction measures cannot begin. When previous construction and later construction must be joined, the latter construction procedure cannot be carried out before previous construction procedures have not been completed, inspected and approved.

(2) Strictly Implement the Quality Responsibility System

In order to have good quality in construction, surveys and designs must guarantee quality. The construction unit must carry out construction strictly according to the designs and blueprints.

Quality control is overall work. Bureau chiefs of construction units should be totally responsible for the quality of engineering construction. The chief engineer should be in charge of technical responsibility. Technical personnel at each level should have duties, authority and responsibility. We must strengthen technical management and strictly implement the system of review and approval. A system of inspection and approval, quality evaluation and issuance of qualification certificates should be implemented for each single project. Large temporary construction projects must also be inspected and approved and their quality must be evaluated. Quality control involves the work quality of each worker. Each construction bureau should establish a quality responsibility system that includes workers, engineering and technical personnel, each business department and leading cadres at each level so that a quality responsibility system can be implemented. Each unit should combine efforts with its own concrete situation to establish rules for reward or punishment regarding quality. Individuals or collectives who have achieved results in good quality construction and made contributions should be appropriately rewarded. Those responsible for incidents which have created serious quality problems and which have caused the state to suffer severe losses should bear economic and legal responsibility. The technical responsibility system, the quality responsibility system and the economic responsibility system should be joined together. All who do not reach the quality criteria are not to be rewarded.

(3) We Must Make Quality Inspection Agencies and the Quality Inspection System Sound

Delegates to the conference suggested that the general bureau strengthen leadership in quality management work. Each construction bureau must restore and make sound the special agencies of the bureau and the departments. Quality inspection agencies must quickly equip themselves and insist on principles according to the needs, manage affairs conscientiously, and have a staff of quality inspection personnel who possesses definite theoretical knowledge and practical experience. The leadership must support the work of the quality inspection department and maintain the duties and authority of quality inspection personnel. Quality inspection personnel have the right to report any quality problems in construction to the leadership of their own units as well as to authorities one echelon higher in authority. When violations of the designed requirements and regulations are discovered during construction and when such violations may cause serious quality problems, the quality inspection department has the right to order a temporary halt in construction and has the right to immediately report the situation to the bureau chief and the chief engineer and to request for remedial measures.

Quality management work must implement the policy of "taking prevention as the key." The quality inspection system and quality inspection method must combine the situation of each bureau so that they may be further perfected. We must

gradually form a quality inspection network of a mass character and implement the three systems combining professional inspection, mass inspection and self inspection. Quality inspection must include inspection at time of delivery of a project for use and inspection of construction procedures. It must also include inspection and an understanding of the preparations for construction and technical logistics to analyze and forecast the quality of construction in time and to provide a reference for improving quality control. Quality problems that occur in the future must be strictly investigated and construction must not continue "until the three aspects are satisfied", i.e., not until the cause of the incident has been clearly investigated, not until the persons responsible have been clearly investigated, not until remedial measures have been implemented, and quality problems must be conscientiously reported.

(4) Basic Work in Quality Control Must Be Done Well

To truly exercise quality control well and guarantee the quality of construction, each unit must compile related rules and regulations, details of implementation, methods of testing and construction records, implement quality evaluation, inspect and test materials according to the unit's own concrete situation before the ministry has compiled all criteria for promulgation. Corresponding technical files must be established to gradually realize standardized and scientific quality control.

(5) Reorganize Quality Control Work, Gradually Implement Overall Quality Control

Strengthening quality control, restoring and surpassing the best levels in the history of the unit are the near-term goals of construction units in quality control work. To implement the spirit of this conference, comrades attending the conference believed that every construction unit must combine efforts with the quality month activities and carry out engineering quality inspection and reorganization within the fourth quarter of this year. Workers must be educated in strengthening quality control on a widespread basis through reorganization. Written reports on reorganization, measures of improvement and distribution of work for next year and the year after next must be submitted to the bureau headquarters before the end of this year.

The present hydroelectric system is still in a learning and exploratory stage in implementing overall quality control. Each bureau must actively launch propaganda and education in this regard. The units at the three test points, the First Bureau, Dahua, Mingjiang Bureau must strengthen leadership, make plans, start out from the actual situation, insist on practical results, conscientiously summarize experience in test operation and gradually popularize quality control.

IV.

The conference conscientiously learned the important directives issued by leading comrades of the Central Committee concerning the implementation of the economic responsibility system in industrial enterprises. Everyone unanimously believed, implementing the economic responsibility system is a

fundamental measure to solve the problem of eating from the "big pot" and to overcome egalitarianism and to mobilize the enthusiasm of the broad number of workers. It is an important reform of the business management system and also a point of breakthrough in reorganizing the enterprises. It must be done. Each unit must liberate ideology and break away from the old confines. Its attitude must be positive and its steps must be steady.

The conference discussed the "tentative method of establishing an economic responsibility system for hydroelectric power construction units" proposed by the bureau headquarters. It believed the direction of this "tentative method" was feasible and it suggested that the method should be implemented on a trial basis after revisions were made. Each unit should combine efforts with the actual situation of the unit itself according to the "tentative method" and establish details and these should be reported and filed with the bureau headquarters.

Everyone believed that the economic responsibility system can be implemented in hydroelectric power construction enterprises by allowing profit sharing after conserving costs, delegation of responsibility for profit and loss and contracting single construction projects. The principle of compensation according to labor performed must be implemented in the distribution of remuneration, and more compensation should be given to more work performed. At present, the following measures can be implemented in general: (1) wages for piece work, including wages for extra work performed and for extra work performed by the small collective; (2) rewards for surplus output; (3) work points given as reward for indexed and itemized work; (4) rewards for completion of quotas and contracted work; (5) floating wages, etc. The measures used by a unit should be based on the characteristic of that unit. Measures should start out from the actual situation and must be determined by seeking truth from facts. Units must not carry out arbitrary uniformity and must not rush into establishing a fixed form. They must continuously summarize experience in practice to gradually develop and perfect these measures.

The conference also believed that in the implementation of the economic responsibility system, regardless of which form is used, we must pay attention to grasping the following principles: (1) it must have a fixed quota of an advanced average; (2) it must guarantee quality of construction; (3) Construction cost is only allowed to drop and it is not allowed to rise; (4) it must be uniformly planned on an overall basis and it must be rationally distributed. At the same time, leadership must be strengthened, and ideological and political work must be strengthened. All basic work must be done well to create conditions for the further popularization of the economic responsibility system.

V.

Comrades attending the conference believed that in order to change the passive situation in hydroelectric power construction within three years and to suit the needs of hydroelectric power construction, the most fundamental aspect is to improve the Party's leadership and strengthen the Party's ideological and political work.

(1) We must continue to conscientiously learn the spirit of the Sixth Plenum and the important talks and lectures concerning the problems in the ideological battlefront by comrades Deng Xiaoping and Hu Yaobang, and overcome laziness and weaknesses in ideological leadership. The leadership of the Party should strengthen itself and be unified to make it easy to overcome the various mistaken trends in time, and to strengthen unity on the basis of insisting upon the four basic principles. The leadership that deviates from socialism and the Party, and the social ideology of engaging in capitalist liberalization must be severely and correctly criticized and necessary and appropriate struggles must be waged against it. We must continue to purge the influence of the "leftist" guiding ideology, and develop the good tradition of criticism and self criticism. We must develop the party style, and adhere strictly to party discipline so that politics will be consistent with the Party Central Committee. At the same time, we must educate the workers to establish hard struggle, to love hydroelectric work and to establish the revolutionary spirit of giving one's whole life to the struggle of developing hydroelectric power. We must promote the style of sharing the worries of the state and make more contributions to the four modernizations.

(2) We must establish and make sound the responsibility system of the chiefs of bureaus and institutes under the leadership of the party committee and the workers' representative conference system under the leadership of the party committee. This is a fundamental measure to strengthen and improve the party's leadership, and it is also a major reform of the leadership system. Each bureau and institute must follow the directives of the Central Committee and the State Council to actively establish the plant manager responsibility system under the leadership of the party and the workers' representative conference system under the leadership of the party committee.

We must continue to implement the policies regarding intellectuals and fully develop the functions of technical personnel so that they will truly have duties, authority and responsibilities.

(3) We must train all personnel well, and we must continue to improve the technical standards and work capabilities of workers. These are a very urgent strategic task. Each unit must strengthen leadership, establish plans for training, use many methods to organize and implement the plans in stages and in groups. People must be trained and personnel must be readjusted to fill the types of work that have not been established. Workers on the frontline can be readjuted to work four shifts so that one shift of workers can be trained in rotation. Units which do not have enough production tasks and which have a large number of idle workers must organize workers so that all workers can receive training.

(4) The style of leadership must be improved. The new situation of building the four modernizations has made higher and stricter demands upon the leadership at each level. We must lift up our spirit, be skilled at learning and work hard. We must delve deeply into the actual situation to grasp problems and we must break way from the limitations and open up new roads. We must have ambitious goals and we must also have a down to earth style of work.

We must have sufficient energy to work and we must insist on the scientific attitude of seeking truth from facts. We must have the courage to defeat difficulties and we must have the courage to renovate and create.

We must care about the life of the workers and pay attention to solving the problems in worker's lives that urgently need to be solved.

During the conference, each unit also reported on the implementation of this year's plans, and made concrete arrangements for the tasks of the next four months. Everyone expressed willingness to exert efforts to complete the various tasks for this year. During the conference, documents related to the plans for surveying, designing, hastening preliminary work and strengthening construction quality control before 1985 were discussed. They are awaiting revision and review before they are issued and implemented on a trial basis.

Finally, comrades attending the conference unanimously expressed the view that the conference had summarized the experience and lessons of the past, unified ideological understanding, clarified the goals of struggle, studied measures to hasten preliminary work and strengthen construction quality control, and established trial methods to implement the economic responsibility system. The comrades attending the conference were determined to work hard in the future to build hydroelectric power, to unite in battle, and to make new contributions in building hydroelectric power.

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CSO: 4013/43

HYDROELECTRIC POWER STATIONS UNDER CONSTRUCTION

Beijing SHUILI FADIAN [WATER POWER] in Chinese, No 3, 12 Mar 82 pp 45-46, 53

[Article by special staff correspondent Tao Jingliang [7118 2529 5328] who wrote the article on the Bezhouba Dam System, and Zhang Jihua [1728 4949 5478] who wrote the rest: "Hydroelectric Power Stations in Construction"]

> [Text] At present, China is constructing some 20 large and medium hydroelectric power projects that are directly under the jurisdiction of the ministries and that supply power directly. They include Gezhouba, Longyangxia, Wujiangdu, Baishan, Dahua, Taipingxiao, Hunanzheng, Ankang, Jinshuitan, Dongjiang, Nanyahe, Lubuge, Tondjiezi, Tianshengqiao, Taipingwan etc. The number of generators installed total more than 100 units and total capacity approaches 10 million kilowatts. In response to the widespread demand from readers, this magazine has especially established this column entitled "Hydroelectric Power Stations Under Construction" to introduce the progress of domestic hydroelectric projects one after the other and important foreign hydroelectric power projects will also be introduced.
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> -- Editor

Changjiang Gezhouba Project

Construction of the Gezhouba hub (See WATER POWER, No 4, 1981) is divided into two phases. First phase construction has been basically completed at present and the project has begun to produce gain. The second phase construction began in December of 1981.

Construction of the first phase began after cofferdams were built along Erjiang and Sanjiang on the left side of Changjiang. Water in Changjiang and navigating vessels all used the main river channel. After the first stage construction was basically completed, the main river channel was closed and the water was diverted to Erjiang and Sanjiang through the structures for draining. Then the dofferdam of the main river was built to store water in

the reservoir and to benefit navigation and generation of electricity. Then, the second phase construction began.

Construction of the first phase began at the end of 1970. Because some major technical problems were discovered and had to be further studied and solved, the State Council decided in November 1972, to halt construction of the main structure. At the same time, preliminary designs were revised. In October, 1974, the State Council gave its approval to begin construction of the main structure again. Since 1977, construction has quickened. In 1981, the main river was closed in January. The reservoir stored water in June and Sanjiang was opened for navigation. The No 1 generator of the Erjiang Power Plant began trial operation and generation in July. A major flood was overcome. The No 1 and No 2 generators of the Erjiang Power Plant were inspected and approved by the state and officially joined production in December, and the No 3 generator began trial operation. The construction project of closing the main river received the state's superior quality construction award in 1981.

The construction projects completed during the first stage of construction included: the earth and rock dam on the left bank, the navigational channel of Sanjiang, the No 3 lock, six scouring sluices on Sanjiang, the non-overflow dam, the No 2 lock, straw and concrete dams, the power house of the power station on Erjiang, installation of the No 1, No 2, and No 3 water turbo-generators and their incorporation into the power network to generate electricity (the No 1 and No 2 generators have a single generator capacity of 170,000 kilowatts each, the No 3 generator has a capacity of 125,000 kilowatts), the guide wall of the floodgate of the plant, 27 sluice gates on Erjiang, the concrete longitudinal cofferdam, transverse cofferdams at the upper and lower reaches of the main river, and two concrete leakage prevention walls at the center of the cofferdam at the upper reaches. The investment in capital construction during the first stage of construction was 2.554 billion yuan.

The scope of the first stage construction extended 1,600 meters along the dam and about 7 kilometers from the upper reaches to the lower reaches. The main projects included: 6.22 million cubic meters of concrete, digging 52.50 million cubic meters of earth, refilling of 25.70 million cubic meters of earth, installing 37,400 tons of metallic structures, drilling 33,900 meters of a curtain of filling holes, 39,432 meters of drainage holes, 65,331 meters of cement fillings, 25,584 square meters of seam filling, and 50,000 square meters of anti-leakage walls of concrete. Although the construction was relatively complex, with the efforts of the builders of Gezhouba, a lot was accomplished during the year of peak intensity in construction. Over 12 million cubic meters of earth were dug. Over 5 million cubic meters of earth were filled. Over 2 million cubic meters of concrete were poured. Metallic structures of 22,000 tons were installed. Many new techniques and new technologies were used and created, therefore, conditions for closing the main river were realized one year ahead of the original schedule, and the period of completion of the first stage construction was also correspondingly shortened. At the same time, 358 kilometers of 220,000-volt high voltage transmission lines were erected.

Up to the end of 1981, the Erjiang Power Plant had generated 225 million kilowatt-hours of electricity cumulatively and had provided strong electric power for the Central China power network. The two locks on Sanjiang had provided passage of 2,909 times cumultatively for 12,967 vessels carrying 1.47 million tons of cargo and 646,000 passenger-times. Transportation is good and the demand for transporting cargo and passengers on Changjiang through the dam was satisfied.

At present, the base board of the floodgate 49 meters downstream on the axial line of the sluice gate on Erjiang and its protective seam are being inspected and repaired and scouring of the surface concrete under the current water flow nearby is being inspected. Final construction of the cofferdam at the upper reaches of the main river and the building of monitoring facilities are being hastened to guarantee that this year, the structures can safely withstand floods. Subsidiary enterprises involved in the second stage construction have already begun construction on an overall basis. The work of digging the earth foundation has begun over a large area. Pouring of concrete on the slope in front of the power station on the main river has also begun.

Longyangxia Hydroelectric Power Station

Longyangxia Hydroelectric Power Station is on the main river of Huanghe inside Gonghe County in Qinghai province. It is the first step power station at the upper reaches of Huanghe. The dam across the river is a concrete arch gravity dam. The tallest point of the dam is 175 meters. The leading arc of the top of the dam is 375 meters long. It is the first tall dam being built in the nation. To guarantee that the reservoir drains flood water of different frequencies and supplies water downstream, and to guarantee the reliability and versatility of the regulatory function of the reservoir, spillways have been built on the mountain top on the right side of the large dam, and medium, deep and bottom drainage tunnels have been built through the dam itself. After completion of the reservoir, the reservoir capacity will reach 25 billion cubic meters and it will be the largest reservoir in the nation at present. The power station is located in the back of the dam with four 320,000-kilowatt generators of a total installed capacity of 1.28 million kilowatts and an annual average output reaching 6 billion kilowatt-hours. By regulating the Longyangxia Reservoir, the annual output of the four hydroelectric power stations at Liuxiaxia, Yanguoxia, Bapanxia and Qingtondxia can be increased by 500,000 kilowatts and over 500 million kilowatt-hours of electricity can be added. After completion of the reservoir, it will serve greatly in flood prevention, irrigation and the prevention of icicles in the lower reaches in Lanzhou, Ningxia and Inner Mongolia. The hydroelectric power station is designed by the Northwest Surveying and Design Institute of the Ministry of Electric Power and construction is carried out by the Fourth Hydroelectric Engineering Bureau of the Ministry of Electric Power.

Longyangxia Hydroelectric Power Station is situated in the Qinghai-Xizang Plateau at 2,600 meters above sea level. Natural conditions are severe, including a lack of sufficient oxygen in the atmosphere, severe cold and strong wind and sand storms. These have made construction very difficult.

Since 1976 when the workers of the Fourth Hydroelectric Engineering Bureau arrived at the site, they have overcome many difficulties and within a period of only three years, they have built an access highway, and a system of wind breakers, and water and electricity supply systems for the site, corresponding accessory installations for construction, a lead flow tunnel with a cross section of 15 x 16 meters and 680 meters long, and an earth cofferdam 62 meters high. Construction quality was good. It withstood the extremely heavy flood of 5,570 cubic meters/second on 18 September 1981 (For details see WATER POWER, No 1, 1982) After it won the battle of flood resistance, the subordinate enterprises of the construction site have partially completed facilities to produce sand, gravel, building materials and concrete. The 20-ton cable crane spanning the two banks has already been installed and tested. Pouring of concrete for the main structure is expected to begin in 1982. Because geological conditions at the dam site are complex, and because the dam site is located in a seismic area with seismic activity of 8 on the seismic scale, to guarantee safety of the dam, the foundations of the dam shoulders must be carefully compared and treated in detail. For this, anchor cables, tunnel plugs and concrete have been used in place of ordinary measures for the transmitting tunnels and for filling.

Baishan Hydroelectric Power Station

The Baishan Hydroelectric Power Station is situated on Songhuajiang inside Huadian County in Jilin province. The downstream dam site is 250 kilometers from the Fengman Hydroelectric Power Station. The water-blocking structure is a concrete gravity arch dam. The power station is underground on the bank of the river. The dam spanning the river has a maximum height of 149.5 meters. The height of the top of the dam is 423.5 meters divided into 39 dam sections. The length of the arc of the top of the dam is 667.76 meters. On the left are two dam sections for additional number of generators. They can house two 300,000-kilowatt generators to be installed during the second phase of construction at Baishan. At a height of 350 meters on the dam are three medium drainage holes (with cross sections of 6 x 7 meters). The top of the dam has four overflow floodgates (with dimensions of 12 x 11 meters). The height of the cofferdam is 404 meters. The total amount of concrete for the large dam is 1.633 million cubic meters. The capacity of the reservoir is 6.215 billion cubic meters. The reservoir is a partial multiple year regulatory reservoir. The power house is on the right bank with three 300,000-kilowatt generators of a total installed capacity of 900,000 kilowatts. The power station has three diversion tunnels with diameters of 7.5 to 8.6 meters and a total length of 832 meters. The main transformer room of the power house and the tailwater pressure adjusting chamber are all underground. The cross section span of the power house is 25 meters, the height of the ceiling is 54 meters, and the length is 115 meters. The total amount of digging for the underground power house and tunnels was about 400,000 cubic meters. The project is designed by the Northeast Surveying and Design Institute of the Ministry of Electric Power. Construction is carried out by the First Hydroelectric Engineering Bureau of the Ministry of Electric Power.

After construction of the Baishan Hydroelectric Power Station resumed in 1976, the passive situation caused by a violation of construction procedures has

been basically turned around and now construction has entered an overall construction stage. Digging of the foundation for the cross-river dam has basically ended. Nearly 1 million cubic meters of concrete for the dam structure have been poured, constituting 61 percent of the total amount required by the design. Over 100 meters of the dam height have already been poured, and most of the dam sections have been poured up to 360 meters (the initial power generating water level is 355 meters. When the lower floodgate stores water, a poured height of 366 meters is required, the initial power generating water level is 384 meters). Digging of the underground power house and tunnels are also basically completed. Construction has progressed from digging to laying concrete. Now, 60,000 cubic meters of concrete have been poured, constituting 35 percent of the total of 180,000 cubic meters. Now, pouring of concrete for the No 2 generator has reached a height of 278.5 meters at the bottom of the cone-shaped tube and the vertical frames for the No 1 generator have been poured up to 278.5 meters. Pouring for the No 3 generator has reached the toggle pipe base board at 271.9 meters. Lining and brick laying for the aquaduct are being prepared. Pouring of concrete for the wells of the three floodgates with intakes of 50 meters tall has been completed and intensive construction is being done on the sludge blocking grid.

The concrete structure of the dam is poured from suspended dippers on a loading bridge. Two loading bridges have been built at altitudes of 312 and 361 meters. Concrete is produced by the mixing towers on the right bank downstream (3 x 1600, 4 x 2400, and 8 x 2400 liters each), then it is transported by light rail down the dam. The 10-ton gate crane on the loading bridge lifts 3 cubic meter dippers into the dam. The metallic structure of the dam and the metallic structure of the intakes are lifted by a 20-ton cable crane. This cable crane is also used for pouring small amounts of concrete. During the digging of the power house and tunnels, pre-stress anchor cables and spraying of concrete were extensively utilized. During construction of concrete wells of the intake floodgates, laser guided hydraulic pressure sliding shutters were used for continuous pouring. When lining and laying concrete for the pressure tunnels, the method of "frame drawing" will also be used.

At present, construction at the Baishan Power Station is intense and the task is difficult. The workers of the First Hydroelectric Engineering Bureau are enthusiastic about their work and are working intensively. They are determined to lower the floodgate to store water at the scheduled time to strive for early generation of electricity.

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CSO: 4013/44

REMOTE SENSING USED TO SURVEY WATER RESOURCES

OW311200 Beijing XINHUA Domestic Service in Chinese 0121 GMT 29 Mar 82

[Excerpts] Beijing, 29 Mar (XINHUA) -- Significant achievements have been made in the first phase scientific research work for the Yalongjiang River water resources development project in Sichuan by more than 200 scientists and technical personnel in close cooperation with electric power and other departments in the past 2 years. The survey and design work for the project is still in progress.

In order to speed up the development of water resources in the Sichuan-Yunnan region, the State Planning Commission entrusted the Energy Research Committee of the Chinese Academy of Sciences and the Chengdu branch of the academy with the task of organizing more than 260 scientific and technical personnel from 18 research institutes and schools of higher learning to conduct various tests and research work in cooperation with the Chengdu Survey and Design Institute of the Ministry of Water Conservancy and Power and a unit of the PLA. Since 1980, they have conducted aerial remote sensing tests centering on the feasibility of building hydroelectric power facilities in the Ertan area of the Yalongjiang River, made evaluations of geologic features for construction work in the Ertan, Tongzilin and Jinping areas, and made comprehensive studies of geologic features, rock mechanics, anti-seismic structure, hydrology and hydraulics for the dam site in the Ertan area.

During the past 2 years, based on the foundation of the studies made by the Chengdu Survey and Design Institute and a unit of the PLA for more than 10 years, those middle-aged and young scientific and technical personnel have completed the most difficult and extensive aerial remote sensing tests in the history of our country for the design and planning of the Yalongjiang Ertan Hydroelectric Power Station. The tests included flights covering a total area of 31,542 square kilometers, infrared scanning of a total area of 5,684 square kilometers and multispectrum photography of a total area of 920 square kilometers. In addition, they conducted spectrum tests of rocks, soil, water level and vegetation in key areas including Hongge, Ertan and Panzhihua, obtained more than 600 sets of data, drew 405 spectral curves and made a comprehensive analysis on the stability of crux of those areas.

CSO: 4013/42

BRIEFS

HEILONGJIANG HYDROPOWER STATIONS--Sixty-seven small hydropower stations with an installed capacity of 38,360 kilowatts have been established in 24 counties in Heilongjiang Province. Last year, small hydropower stations generated 75.6 million kwh of electricity, a record in the province. At present, 25 hydropower stations are under construction in 12 counties. Upon completion of these stations, the annual power output by small stations will increase to 90 million kwh. The province is abundant in hydraulic resources, but only 5 percent of them have been exploited. Therefore, all localities should quickly build small hydropower stations if conditions permit. [Harbin Heilongjiang Provincial Service in Mandarin 1100 GMT 18 Mar 82 SK]

CSO: 4013/49

PROMOTING PRODUCTION AND CONSTRUCTION OF COAL INDUSTRY

Beijing MEITAN KEXUE JISHU [COAL SCIENCE AND TECHNOLOGY] in Chinese, No 1, 25 Jan 82 pp 1-3

[Article by the Editorial Department of this magazine: "Hasten the Speed of Developing Coal Production"]

[Text] Over the past 2 years and more, the workers on the coal front have responded to the call by the Party, implemented the Party line, carried out the eight character policy, exerted efforts to hasten the readjustment of the progress of construction, hastened the speed of building and developing coal mines, strengthened safety measures, reorganized business enterprises, began some reforms, and completed the various tasks of readjustment and the buildup in production better.

A new year has begun. The tasks faced by the coal industry are more difficult and more glorious. In 1982 and during the whole "Sixth Five-Year Plan" period, the coal industry must keep pace with the speed of development of the national economy. This means, starting from this year, the readjustment tasks that have not been completed should be completed, and the output of coal must be kept at a fixed rate of growth to satisfy the ever increasing daily need for coal in national economic development.

A rapid increase in the output of coal involves expanding reproduction by extension on the one hand and expanding reproduction in intensification on the other hand. Our nation has coal resources and the coal industry has a good foundation. Whether by extension or intensification, there is the potential for expanding reproduction. The problem is to adapt such efforts to the economic pattern, rely on scientific methods, work concretely, and not rely on sudden efforts which will result in future troubles.

I. Hasten the Speed of Building and Developing Mines, Reform the System of Production at Large Coal Mines, Shorten the Construction Period, Produce Coal Ahead of Schedule

To shorten the construction period and to strive to increase the number of coal mines which can begin production each year and to guarantee necessary extension and expansion of reproduction, a lot of work has to be done. A lot of work has to be done, whether in readjustment or reorganization, in geology,

design, scientific research, organization of construction, the quality of construction, reforming the system, economic policy and utilization of foreign capital. In particular, reforming the system of production at large mines and designing work seem to be even more urgent tasks.

One of the main reasons affecting the construction period of mines at present is that the amount of work involved in designing is large and the tunneling distance is long. Therefore, how to improve the deployment of excavation in design and rationally reduce the amount of construction for building tunnels is a problem that waits immediate solution. For many years, some experience has been accumulated in this regard. For example: Where conditions are suitable, level tunnels and inclined shafts should be excavated first. At the beginning, the stopes should be placed near the pit shafts as much as possible, and excavation should be done by advancing the stopes and retreating the faces. The positions of ventilating shafts should be rationally selected and the distance of tunnelling should be shortened. Consideration should be given to using one shaft for many uses. At the beginning, centralized ventilation should be used as much as possible. At mines with favorable conditions, stopes should be established simultaneously while ascending and descending. Coal extraction technology should be reformed. The positioning of tunnels should be improved. In coal seams where conditions are suitable, inclined long wall extraction and extraction without using coal columns should be used and more coal tunnels should be dug. The degree of mechanization of extraction and tunneling should be improved. Production should be rationally centralized. The productive capabilities of the stopes and the faces should be improved. When the conditions are favorable, old pits nearby or ventilation shafts of stopes should be utilized as much as possible for tunnelling new pits. When the conditions are suitable, floor type windlass and steel cable coal tubs should be used as much as possible. The setup of industrial facilities should be improved to conserve land and to reduce the number of coal columns in the fields as much as possible, and the amount of nonproductive construction of tunnels should be reduced. All of these can be selectively utilized after technical and economic comparison.

Reforms are also necessary in the system of production at new mines. All parts of a large mine should be designed at once and constructed in stages to produce coal earlier. For over 30 years, our nation's schedules for completion and production of coal mines have been changed back and forth several times. At present, regardless of size, construction of all new mines is supposed to be completed at once and the mines should begin production after completion. Among the mines being built at present, large mines constitute about 90 percent. In this way, the construction period would necessarily be long and the newly built mines cannot quickly produce benefits from investment. At the same time, if production is not reorganized in time, the construction project must be maintained and even when the construction project has been completed and the facilities handed over for production, a lot of work has to be redone and tunneling has to be redone. Building mines in stages is a good method to produce coal earlier and to reap benefits earlier.

Designing a large mine at once and building the mine in stages to produce coal earlier should be based on the actual situation of the mine. In the

design, the most economical and most rational method of construction should be selected. For example: If the coal seam is shallow, the shallow part can be extracted from many pit shafts in separated zones. Ventilation should be set up for separate zones to produce coal earlier. In large mines, if the coal seam is deep, stopes near pit shafts should be built first to produce coal earlier. At mines where conditions are favorable, consideration can also be given to utilizing ventilation shafts for producing coal earlier but the problem of transport must be solved.

Designing a large mine at once and building the mine in stages to produce coal earlier require that the design establishes corresponding standards for construction of each stage to prevent premature production. The present construction order of first building the bottom of the mine pits and then building the upper parts in current construction of mines must be changed. After the pit shaft has been sunk, the first stage of the stopes must be built first to quickly form a bottom and top production system for the shafts. Therefore, civil engineering work and installations must be done earlier, special railroad lines, power supply, land purchases and moving of villages must be arranged early to adapt to the need for producing coal earlier. Construction of large mines in stages for those large mines currently being built involves a broad area and the problems are more complex, and it must not follow a fixed pattern. Each mine must be studied and built individually.

II. Build a Group of Medium and Small Mines in Regions With Suitable Conditions

The problem of the type of mines directly affects the results of investment and the results during the construction period. The size of the mines should be determined by considering the resources of the coal fields, the conditions of development, and the topography, concrete conditions of production, need and transport and by adhering to the principles of less investment, quicker output of coal and large economic benefits. Those mines which should be large should be large and those which should be small should be small.

It is entirely necessary to build a group of modernized large coal bases according to plan and step by step in view of the overall situation of the national economy and long range development. But, considering the urgent need for energy resources, in the near term, more medium and small mines of less than 900,000 tons should be built to shorten the construction period and to realize benefits earlier.

To quickly build this group of medium and small mines, first, we must build up old mining areas that have suitable conditions and their peripheral fields and fully develop the strength of the old mining areas, and implement the three guarantees system (guaranteed investment, guaranteed construction period, guaranteed output). Second, we must "plan for the whole, design it at once, start out from the small and then build the large ones, start out from the shallow seams and then exploit the deep seams, start out from the small pits and expand to the large pits" in regions where the reserves are rich and are buried at a shallow depth. We should first build a group of medium and small mines. After a few years, we could carry out technical improvements and combine these small mines with the deeper large mines. When building medium

and small mines, we must uniformly consider the limits of the depth of excavation, the procedures of excavation, the setup of the site, power supply, water supply, railroad transport and such productive systems and living facilities. In the past, many large mines and pits of the Jixi, Datong, Yangquan and Xishan mining bureaus used this method. They started out from the small to the large and they developed gradually. Using this method, investment during the first period of construction can be conserved. The construction period is short. Coal can be produced earlier, and the mines already built can serve later mines. This group of medium and small mines must be built quickly and well and they must produce results within about 3 years. The condition is that they must have reliable resources and nonproductive pits must not be sunk. The productive system and the living and welfare facilities of the mines must be matched. Premature production must not be carried out. There must be long-range plans and overall planning.

III. Technical Improvements Must Be Carried Out Step by Step for Presently Existing Coal Mines

Carrying out technical improvements is a strategic measure proposed by the Central authority. If old enterprises are not rebuilt, and if they continue to use out-dated and old technologies and equipment, consumption cannot be reduced, quality cannot be improved, and good economic results are difficult to realize. The technical improvement of mines should be based on the principle of spending less money to do more work. Guidance must be categorized according to different situations and according to the concrete conditions of the mines.

1. The mines with rich reserves, where mining conditions are good, where traffic is convenient should be the key points for technical improvement. We must select a group of mines for overall consideration and overall improvement of their productive capability, their system of production, technical equipment, safety measures, washing and processing procedures, ground storage and transport and living and welfare facilities so that production can be increased and the economic gain can be improved with less investment and within a shorter time.

2. Some mines in coastal regions do not have a rich reserve and mining intensity is high. The rate of utilization of their capabilities has already surpassed the original design. In the future, their present production level should be stabilized and their technical and economic indices should be improved by improving individual links, filling the gaps in safety measures and implementing necessary renovation of equipment. There are also some mines that have favorable conditions for expansion and they should be expanded early. These mines have good transportation and their role can be better developed.

3. In the inland regions, there are many mines with rich reserves but because of the limitations of the condition for transportation, the rate of utilization of the capabilities of the mines is generally only about 60 percent. At present, the main efforts should be to improve the conditions of transportation and to develop the designed capabilities of the mines. In the future, some mines with conditions for shipping coal to other localities should be selected

for improvement and expansion. In technical improvement of mines, we must pay attention to the renovation of technology, techniques and equipment, we must pay attention to increasing unit output, increasing unit tunneling, increasing the recovery rate of resources, we must guarantee safety, and we must change the situation of the backward technology at the mines. All expanded mines must have a reliable geological reserve. After expanding the productive capability, a definite number of years of service of the mine and the level of production must be guaranteed. The proportional relationship between excavating and tunneling must be coordinated, and the production links, the living and welfare facilities and the systems for ground storage, loading, transport and selection must also be matched correspondingly.

Resources must be actively sought in old, run-down mines. Measures must be taken to extract coal from coal columns, residual coal, accumulated coal under buildings, railroads and bodies of water, and the life of the mines should be extended as much as possible.

IV. Develop Mechanized Mining, Add Some Equipment for Comprehensive Mining, High Grade General Mining, and Tunneling and Transport Machinery

Comprehensive mining can produce a high output. It is highly efficient and safe, and its production is centralized. It is the direction of future development in coal mining technology. At present, the output from comprehensive mining in our nation already constitutes over 17 percent of the output of stoping at uniformly equipped coal mines, and it has already become an indispensable means for stable and high output at some major mining areas. In fiscal year 1981, the faces of comprehensive mining throughout the nation produced an average annual output reaching over 400,000 tons, equivalent to the output of a medium mine. In the future, comprehensive mining should be developed according to plan and step by step according to the nation's economic strength. It should progress from position to position to realize "three priorities", i.e., equip newly built large mines with conditions suitable for comprehensive mining as a priority, equip old mines with a rich reserve and which can improve their comprehensive productive capabilities by a large scale through technical improvements, and equip coal mining faces where the use of comprehensive mining can visibly improve the stoping rate or can effectively solve the problems of safe production.

Renovating general stoping equipment and developing high grade general stoping at key localities have practical significance in improving unit output and work efficiency at the present stage. In 1977, our nation developed high grade general stoping equipment on our own. We used single unit hydraulic props, coal extracting machinery of larger power, the model 150 bendable transporting equipment and conveyors, elastic belt conveyors and such matched equipment to replace the friction type metal props, the model 80 coal extracting machinery, the model 40 transporting equipment which have been used since the 1950s and 1960s. Good technical and economic results have been obtained. According to statistics compiled in September, 1981, the average monthly output of the faces of high grade general stoping in the uniformly equipped mines throughout the nation was 75.69 percent higher than ordinary general mining, the work efficiency was improved by 18.41 percent and safety conditions were improved. High grade general stoping should be popularized as the key of the present stage.

Mechanization of mining thin coal seams is a weak link in present production. To hasten the progress of stoping thin coal seams and guarantee the proportional mining of thick and thin coal seams, we must actively create conditions and hasten the development of mechanizing mining of thin coal seams.

A lot of experience has already been accumulated in hydraulic mining of coal in our nation. Under definite conditions of the coal seams, hydraulic mining has obvious superiority. We should study and improve existing problems and actively implement hydraulic mining at places where conditions are favorable.

Stoping and tunneling should be carried out simultaneously and tunneling should be in the leading position. Tunneling through rock tunnels must be centered around mechanized loading to build a mechanized line of operation with matching equipment. We should also popularize directional guidance by laser, wet drilling of rocks, deep hole clean surface blasting, anchored sprayer props and protectors, comprehensive dust prevention, regular circular operation and such experience to hasten the speed of tunneling. Coal tunnels and half coal and half rock tunnels should be worked using mechanized loading as the key point to realize matched mechanized operation, and in tunneling larger sections and comprehensive stoping tunnels, we should gradually develop coal tunneling machinery and accessories, and at the same time, popularize flexible metal sheds step by step.

Transporting coal in stoping regions should use conveyor belts. The original system of tracks in large coaling tunnels at mines with a potential for producing increased output can be utilized for running 3-ton hopper bottom cars. Mechanized operation and joint operation can be implemented at the pitheads or at the bottom of the pits to improve the coaling and lifting abilities and to adapt to the needs of increased output of coal.

V. Implement Policies That Provide Assistance to Local Mines, Carry Out Technical Improvement Step By Step, Increase the Output of Local Coal

Local coal mines are an important component of the coal mining industry. They bear over 40 percent of the production task. To guarantee the need for coal in national economic development, we must assist and develop local coal mines in a big way. One is to implement economic policies that assist local coal mines to develop the enthusiasm of developing coal at all levels. The second is to implement unified planning, establish mining zones, rationally utilize coal resources. The third is to select the sites according to superior conditions, follow the principle of practical results, carry out technical improvement step by step, and improve safety and productive conditions. With such efforts, the proportion of backbone pits of local mines can be continually increased to meet the demands for stable and high output and safety standards.

9296
CSO: 4013/6

EXPERIMENTAL PLANT USES STONE COAL FOR POWER GENERATION

Beijing GUANGMING RIBAO in Chinese 18 Feb 82 p 2

[Article by staff reporters Zhou Wenbin [0719 2429 2430] and Zhang Zuhuang [1728 4371 3874]: "An Undertaking of Bright Prospects--A Report of Investigation On Yiyang Stone Coal Power Generation and Comprehensive Use Experimental Plant"]

[Text] Editor's Note: On the question of the comprehensive use of stone coal, there is a lack of successful experience at home and abroad, and therefore there are different views. In past 4 years, Hunan Province's Yiyang Stone Coal Power Generation and Comprehensive Use Experimental Plant has conducted research and made experiments. It has made fairly good progress in technological and economic fields. The following report of investigation explains the experience of this plant for the reference of departments concerned.

Hunan Province's Yiyang Stone Coal Power Generation and Comprehensive Use Experimental Plant undertakes the state project of intermediate experiment in exploring the use of stone coal resources. It includes three sections of a power generation plant, a building material factory and a vanadium factory. The work of construction began from 1977, and test operation started from 1978. Till the end of 1981, the power plant had run 5,598 hours and generated about 30 million kilowatt-hours of electricity, including 1,124 hours of continuous running in 1980 and over 2,700 hours of running in 1981. During the same period, the building material factory had test run 2,000 hours and used the stone coal cinder to produce more than 1,600 tons of brick-laying cement and clinker-free cement and 3,000 pieces of small flat cement tiles; and the vanadium factory had extracted more than 7,000 kilograms of dry red vanadium from the ashes of the power plant. The results of the test operation show that the comprehensive use of stone coal is indeed an undertaking of bright prospects. It is not only practicable technologically but also rational economically.

Stone coal is a rich energy source in the southern part of our country. The statistics of some provinces (regions) shows that up to 1981 the proven deposits reach more than 60 billion tons, of which more than 18 billion tons are in Hunan Province. The calorific capacity of most stone coal is between 1,000 and 1,500 kilocalories per kilogram, and that of good coal may reach even 4,000 kilocalories per kilogram. Yiyang Experimental Plant tried to

resolve key technical and economic problems on the use of stone coal and selected purposely coal of poor quality with a calorific capacity of only 900 kilocalories per kilogram. The success of this experiment not only will provide the vast areas of southern China with valuable experiences of exploring and using resources of stone coal, but also will open up a practicable way for the coal-producing areas in the north to use large quantities of gangue.

In the past some provinces had conducted experiments of using stone coal to generate electricity. However, in all cases they simply altered the boilers of the old power plants, and the heat efficiency was not good enough. Moreover, the power plants were not in places where stone coal was produced, and had in addition many difficulties of transportation. Also, they did not make use of the large quantities of cinder. Consequently, these experiments gave people the impression that the use of stone coal was technologically not practicable and economically not rational. As a result, for a while we made no progress in using stone coal.

Is the use of stone coal technologically not practicable? On this question, there have been some unfavorable comments. First, people thought that it was difficult to improve the heat efficiency of boilers. Next, they found that stone coal could not be crushed easily, and that the wear and tear of the broad hammer of the crusher was too serious. Besides, the excessive electric power consumption was also an obstacle. On these questions, Yiyang Experimental Plant found fairly good solutions and, thus, carried out its operation with safety, full load and stability. The plant is using a boiler of the capacity of boiling 35 tons of water per hour, with heat efficiency reaching above 60 percent and average consumption of stone coal at 5.3 kilogram for each kilowatt-hour of electricity, that is, 720 grams of standard coal, approaching the performance of a similar generating set burning good coal. The operation of the plant's 6,000-kilowatt generating unit is also approaching full load. With the renovation of the crushing system, the size of coal granules is basically between 3 and 9 millimeters, meeting the burning requirement of the boiler. They improved the broad hammer of the crusher with material of better quality, and the life of the hammer is greatly prolonged with no unusual trouble of wear and tear. At present, the plant has reduced its power consumption to below 16 percent, which is still higher by about 6 percent than a similar power plant burning good coal. With technical renovation, it will be still possible to make further reduction. These facts indicate that the technique of power generation with stone coal has basically reached maturity.

Furthermore, from the economic point of view, if we take into consideration the economic benefits from the comprehensive use of stone coal, such as the saving of energy and the reduction of production cost in making building material from cinder, and the economic value of vanadium and other rare metals extracted from cinder, common power plants will be beyond compare. The comprehensive use of stone coal is of positive significance in protecting coal resources, in mitigating pressure on transportation, and in making up the shortage of building material. The brick-laying cement produced by Yiyang Experimental Plant not only is well received by the users for its fine quality

and low price but also fills up a gap in the variety of cement in Hunan Province. In consideration of only its use for power generation, the economic value of stone coal is also quite high. Though the experimental plant has used stone coal of poor quality, the current cost of generating every kilowatt-hour of electricity approaches that of similar power plants burning coal of fine quality in Hunan Province. Moreover, most of these plants have installed twin-generator units in operation, and are subsidized by the state for the purchase of coal. If a stone coal power plant burns stone coal of slightly better quality, or installs twin-generator units in operation, its cost of power generation will evidently be further reduced, and may become even lower than that of power plants which burn coal of fine quality. At present, though Yiyang Experimental Plant carries out its operation on an experimental basis, it has already brought about very great economic benefits. If we calculate its output value at 2 yuan per kilowatt-hour of electricity, the plant has supplied more than 24 million kilowatt-hours of power (excluding power consumed by the plant), and has made nearly 50 million yuan in output value, equal to more than 6 times its total investment of a little over 7 million yuan. If the plant comes into regular operation, each year it will supply over 18 million kilowatt-hours of power and bring about even more impressive output value. In the face of these facts, the view that economically it does not pay to generate power with stone coal can hardly hold its ground.

At present, with the support of leading departments concerned, the staff members and workers of Yiyang Experimental Plant are striving to further strengthen and improve their present success, and to enlarge the scope of the comprehensive use of stone coal. We can expect that the comprehensive use of stone coal will show more and more fully its superiority.

9039
CSO: 4013/31

GANSU SURPASSES PLAN FOR RAW COAL OUTPUT

Lanzhou GANSU RIBAO in Chinese 16 Feb 82 p 1

[Article by Luo Zhaolu [5012 2507 4389]]

[Text] During the readjustment of the National economy, Gansu's energy resources industries have achieved good results. In 1981, the raw coal production of our province has reached 7,737,500 tons, surpassing the planned amount by 8.98 percent and exceeding 1980 production by 0.98 percent. The seven coal mines (Yaojie, Agan, Jingyuan, Tianzhu, Shandan, Kiutiaoling, Huating) administered directly by the provincial government have surpassed their annual quotas by 293,800 tons.

Progress in electric power production lagged behind previous years, but the result is quite good since power consumption also decreased. For 1981, Gansu's total power generation reached 12,125 million KWH, surpassing the planned figure by 2.8 percent and exceeding 1980 production by 1.5 percent. The 15 power stations administered directly by the provincial government achieved their annual goals.

The petroleum industry also achieved good results in the development of oil fields and in oil production. Under the administration of the Petroleum Bureau of Yumen District, 31 annual production and manufacturing indices (total production, feet of well-drilling, crude oil production, crude oil processing, machine manufacturing, etc.) have achieved their goals. The Changqing oil field also achieved its annual goal of crude oil production ahead of schedule.

9899
CSO: 4006/300

JINZHOU REFINERY MAKES BIG PROFIT

Shenyang LIAONING RIBAO in Chinese 21 Jan 82 p 2

[Article by staff reporters Liu Weiye [0491 4850 2814], Tian Xiangyang [3944 0686 7122] and Wang Xinming [3769 2450 6900]: "Refinery No 6 Goes Ahead in Processing Technology"]

[Text] Jinzhou Refinery No 6 concerns itself about the comprehensive use of oil resources, presents continuously new topics on technical renovation, goes ahead into the depth of processing, produces desired results quickly, and gains excellent economic benefits. In 1981, the refinery made a profit of 114 yuan from processing every ton of crude oil, which is higher by 84.2 percent than the national average of 61.86 yuan in 1980. Its earning power is highest among all oil refineries of our country. With its profit handed over to the state in one year, it is possible to build a new refinery of the same scale.

Jinzhou Refinery has increased its output very quickly by carrying out repeatedly technical renovation, extension and new projects. The leadership of the plant analyzed the situation of production and held that though the plant increased its output year by year in the past, it had not done enough in such fields as the comprehensive use of crude oil and the more refined work of processing. For instance, the refinery released a large amount of petroleum gas which contains many kinds of chemical components. In the past, the gas was simply liquefied for use as fuel. At present, for its comprehensive use, the plant has laid down overall plans for technical renovation and equipment renewal, and also has set a schedule to carry out the reform projects one by one by stages and in groups.

Isopropyl alcohol is one of the valuable chemicals which can be extracted from the petroleum gas. In the past, the refinery used outdated technology to produce isopropyl alcohol, its equipment was obsolete, and the pollution of the "three wastes" (waste gas, waste water, and industrial residue) was serious. Over a long period of time, production could not be carried out on a large scale. In 1977, they renewed and renovated the equipment for producing isopropyl alcohol, improved the production technology, and boosted the output from some 600 tons to 3,000 tons. Last year, the plant took the advantage of carrying out a general overhaul of its equipment, increased the height of the deetherification column--a key section of the equipment, and carried out

corresponding reform of the technological process with the addition of a deodorization device. Consequently, the equipment and technology for the production of isopropyl alcohol reached the international advanced standard, the annual production capacity increased to 10,000 tons, and the Ministry of Chemical Industry approved the fine quality of the product. Furthermore, the plant carried out corresponding extension and new projects on the comprehensive use of liquefied gas as raw material to make such articles as additive for petroleum, synthetic rubber, cyclobutyl sulfone and other products, and raised its productive capacity. At present, the output value of its products extracted from liquefied gas alone in one year reaches 150 million yuan, with a profit of 50 million yuan. They constitute one quarter of the refinery's total output value and profit.

9039
CSO: 4013/31

SICHUAN NATURAL GAS PRODUCTION

Beijing DILI ZHISHI [GEOGRAPHICAL KNOWLEDGE] in Chinese No 2, 1982 pp 9-10 (Excerpt)

[Article by Zhou Shikuan [0719 0013 1401]: "New Face of Luzhou"]

[Excerpt] Development of Natural Gas and Unique Chemical Fertilizer Production

While surveying Luzhou, we took a special inspection trip to the Southern Sichuan Natural Gas Mines and the Luzhou Natural Gas Chemical Plant. We were deeply impressed. Our nation has a long history of developing natural gas. As early as 250 BC, during the Qin dynasty, governor Li Bing and son and the broad number of laboring people dug canals, sank wells in Sichuan and discovered natural gas. The natural gas in Sichuan was utilized during every subsequent period, but the scale was not large. The discovery and large scale exploitation of the rich natural gas resources in the Southern Sichuan area began after liberation. Official surveying and exploration began in 1956 and production of natural gas began in 1959. After more than 20 years of hard work, a large southern Sichuan natural gas mining area centered around Luzhou was finally built. By 1979, natural gas production was 2.9 billion cubic meters/year.. The natural gas resources here are rich and the distribution is broad. There are natural gas fields distributed in the north from Longchang County to Shuyong County in the south, and west from Changning County to Jiangjin County in the east. The natural gas fields here have the following characteristics: The individual fields are small in area, the distribution is scattered, yet they are "small but fertile" gas fields and generally their reserves are large. Today, the natural gas reserves already obtained by the Southern Sichuan Gas Fields constitute one-fourth of the total reserve of natural gas in Sichuan. In 1979, 27 gas fields had already been developed. Their output constituted 45 percent of the total yield in Sichuan. At present, they constitute the largest natural gas production base that has already been built at present in our nation. When we went to the gas fields to inspect, we saw well props standing one after the other and extending into the sky. Every extracting pump was working continuously and there was a criss-cross network of gas pipes, and vehicles filled with equipment were going here and there. This busy production scene made us feel happy! The comrades at the gas fields told us that here, natural gas resources are rich, and the gas fields are the crevice type and are easily exploited. The gas producing layers

are relatively shallow. The mines mainly extract the gas of the geostrata of the Triassic Period and the Permian System. At the same time, the quality of natural gas is good, the content of methane reaches over 95 percent and the sulfur content is low. The gas is a dry natural gas. Its value for industrial utilization is very large. It is the ideal raw material for producing synthetic ammonia, methanol, methyl and carbon black and such chemical products. To use natural gas as raw material for chemical production and industrial production and as fuel for cities, we need to continuously transport natural gas to the factories and cities. The criss-cross network of gas pipes at the Southern Sichuan Gas Mines is connected to the main pipelines of the Sichuan provincial network. High pressure natural gas is sent to Changdu, Zigong, Yibing, Chishui, Naxi to satisfy the needs for industrial production and urban living.

The plant was built as our nation's first large nitrogen fertilizer plant to utilize natural gas to produce synthetic ammonia when natural gas was massively exploited in 1964. In two years, the plant acquired the capacity of producing synthetic ammonia of 100,000 tons/year and 180,000 tons/year of urea and became our nation's earliest plant to be equipped with large nitrogen fertilizer producing equipment. There is a rich source of natural gas underground here, and the location is near the large river. Water sources are sufficient, river navigation conditions are good, and thus these factors have promoted the rapid development of natural gas chemistry.

9296
CSO: 4013/55

TAIYUAN COAL GASIFICATION EFFORTS STEPPED UP

Taiyuan SHANXI RIBAO in Chinese 16 Feb 82 p 1

[Article by Zhou Enying [0719 1869 5391], Yang Hengshan [2799 1854 1472]: "Strive to Realize Coal Gasification in Taiyuan Early, Preliminary Work for the 400,000-ton Coking Coal Gasification Project Is Basically in Order, Total Investment This Year Will Be Over 45 Million Yuan"]

[Text] Provincial Governor Luo Guibo [5012 6311 3134] and responsible comrades of Taiyuan City place a lot of emphasis on coal gasification in Taiyuan City. Since the beginning of this month, they called together concerned personnel twice continuously to study the allocation of investment for coal gasification and concrete construction plans. They also went deeply into the construction sites to understand the situation personally and to solve problems.

Since the founding of the Taiyuan Coal Gasification Company in May of last year, the speed of construction for coal gasification in the city gradually quickened. The project for production of liquid petroleum gas by the Taiyuan Detergent Plant has been completed and has begun test production. Before the spring holidays, ten residential families on Jiefang Road began testing bottled liquefied gas. The portion of the project to utilize surplus gas of the coking furnace of the Taiyuan Chemical Fertilizer Plant has been basically completed last year. Over 9 kilometers of pipes have been laid outside the plant. Over 700 families of residents around the First Taiyuan Thermal Power Plant used piped coal gas in December of last year. The preliminary work for the construction of the 400,000-ton coking coal gasification project is also basically in order and "opening of three channels and leveling" have been achieved.

At the beginning of February, Provincial Governor Luo Guibo held a special topics conference which studied the plans for the coking coal gasification project. On February 9, the provincial planning committee and the provincial capital construction committee officially issued the full-year plan for this project involving a total investment of 45.4 million yuan. On the afternoon of February 13, responsible comrades of the province and city Luo Guibo, Wang Maolin [3769 5399 2651], Ma Guishu [7802 6311 2579], Shen Chong [3088 6850], Niu Fahe [3662 4099 0735] and responsible comrades of the provincial and municipal planning committees and capital construction committees again went deeply into the Taiyuan Coal Gasification Company and the Taiyuan Coking Plant to survey and to understand the situation of implementing the plan and to help

solve actual problems. Comrade Luo Guibo repeatedly emphasized: The leaderships of the construction units and the building units must improve the style of work, move to the construction sites to work, strengthen command and management of construction. The broad number of construction workers must develop the spirit of hard struggle and aventure, strengthen the sense of being the master, and hasten the speed of building the coal gasification project so that Taiyuan can realize coal gasification early.

9296
CSO: 4013/34

SPEEDING UP THE DEVELOPMENT OF PRODUCING TOWN GAS FROM COAL

Beijing MEITAN KEXUE JISHU [COAL SCIENCE AND TECHNOLOGY] in Chinese, No 1, 25 Jan 82 pp 8-11, 20

[Article by Ou-yang Yuan [2962 7122 3220] and Li Shilun [2621 1597 0178] of the Gasification and Liquefaction Office of the Coal Science Research Institute: "Hasten the Development of Urban Coal Gas From Coal"]

[Text] The development of urban coal gas is an important component of urban modernization. It is an important measure to reduce environmental pollution, conserve energy, provide convenience to the people and masses, and develop industrial production. In the world, gasification of civilian fuel in cities has become the major direction of development. Industrially advanced foreign nations have already used urban coal gas widely. Over 85 percent of the urban residents in the United States and France use coal gas and the percentage in Japan has reached 98 percent. Direct burning coal is the main way in our nation at present. Among the 88,000,000 urban population throughout the nation at present, only 16,000,000 urban residents use coal gas. The percentage of use is about 18 percent. In recent years, the bad results caused by direct burning of coal have become more and more obvious. The call for the use of gas by city dwellers and concerned departments has become louder. We must implement the spirit of the directive of the party's Central Committee, hasten the development of urban coal gas, and exert active efforts to change the situation in the cities as soon as possible and to realize urban modernization.

I. There Are Many Benefits in Developing Urban Gas

Developing urban gas benefits environmental protection and reduces atmospheric pollution. The fuel for civilian use and for our nation's urban industries is mainly coal. According to estimates, each year, 15,000,000 tons of dust and 12,000,000 tons of carbon dioxide and other harmful substances are released into the atmosphere from burning coal. These pollutants seriously harm the people's health and they constitute a real damage to the cities. Only by developing urban coal gas in a big way and providing clean gaseous fuel to the cities can this pollution be fundamentally changed.

Developing urban coal gas can improve the rate of utilization of thermal energy by a large scale. Direct burning of coal has a low rate of utilization of thermal energy. The rate of utilization of thermal energy of household

coal burners is only 15 to 18 percent. If coal gasification can be used to produce coal gas, the total rate of utilization of thermal energy can reach above 30 percent. According to estimates, the amount of coal gas produced by gasification of one ton of coal provided for civilian use is equivalent to the results of directly burning 1.5 to 1.9 tons of coal. If the 20 key cities exerting efforts in environmental protection and some cities which have favorable conditions for developing coal gas throughout the nation could be provided with urban gas first, the population using coal gas would reach 40,000,000, and each year, about 7 million to 8 million tons of coal could be conserved.

Some special industries producing high technology products, precision products and pioneer products in the cities must use gas to assure the quality of the products. As city buildings become taller, continued burning of coal or liquefied petroleum gas has become very inconvenient and is also not safe enough. Changing from direct burning of coal to burning coal gas can provide a great convenience to the masses. According to estimates, each family can reduce family chores by over 500 hours each year.

In general, developing urban coal gas has already become an urgent and major task.

II. Suit Measures to Local Circumstances and Select Appropriate Gas Manufacturing Technologies

For a long time, our nation has always used coal gas of medium thermal value produced as a by-product from coking for urban gas. According to the actual situation in our nation, the coal gas of medium thermal value used for urban coal gas must satisfy the following requirements:

(1) The thermal value of the coal gas must be greater than 3,500 kilocalories/-cubic meter of standard coal. Only under special individual conditions and only when technical and economic comparison show that it would be rational, could coal gas with a slightly lower thermal value be used.

(2) The content of carbon monoxide is low. Foreign nations usually require that the content of carbon monoxide in urban coal gas should not surpass 10 percent. Our nation's coal gas from coking can satisfy this requirement but the coal gas produced by other technologies should also adhere to such strict standards for carbon monoxide content.

(3) The harmful substances of hydrogen sulfide, ammonia, tar and dust must also be purified to reach the established criteria. For example, hydrogen sulfide content should be less than 20 milligrams/cubic meter of standard coal, and the content of tar and dust should be smaller than 10 milligrams/-cubic meter of standard coal.

There are several methods of using coal to manufacture urban coal gas of medium thermal value. Deliberations on how to select a suitable method must be based on the technical conditions of our nation's industries and they must be combined with the conditions of supply and the varieties of fuel coal by

suiting measures to local circumstances and by suiting measures to the conditions of coal. At present, there are the following major methods of selecting coal:

1. Removal of solid residues and pressurized gasification

This utilizes lump coal of a definite granularity (6 to 24 millimeters or 6 to 50 millimeters). Lump coal is subjected to a pressure of 20 to 28 kilograms/-square centimeter and a temperature of 900 to 1100°C. Oxygen and steam are used to produce coal gas of medium thermal value. The efficiency of gasification of this technology is 68.3 percent. The thermal value of pure coal gas differs according to the type of coal and reaches 3,500 to 4,000 kilocalories/-cubic meter of standard coal. The output can reach 900 to 1,000 cubic meters/-ton of coal (converted according to a thermal value of 4,000 kilocalories/cubic meter of standard coal).

The characteristic of pressurized gasification and removal of solid residues is that the output is large. It is $\sqrt{P}$ times that produced by the gasification furnace of the same diameter under ordinary pressure (P is the pressure inside the furnace). The coal gas contains a dozen or so percent of methane. The thermal value of coal gas has been increased, making the coal gas suitable as coal gas of medium thermal value. This technology can utilize lignite and non-caking and slightly caking bituminous coal. The coal gas produced has surplus pressure of over 20 kilograms/square centimeter and it does not need to be pressurized for transporting it to more distant localities.

This technology is suitable for use in large cities. Building a plant with a daily output of 1 million cubic meters of coal gas of medium thermal value requires 3 pressurized gasification furnaces of 3.8 meters in diameter (two operating and one backup). Annual consumption of bituminous coal is about 400,000 tons. The output of coal gas can be provided to 400,000 families for use.

The main shortcoming of pressurized gasification of solid residues is that this process requires the use of lump coal. The consumption of steam is large. The process produces a lot of waste water containing phenol and it requires a complete facilities for processing waste water and tar. Using this gasification technology to establish coal gas plants requires large investment. The cost of the coal gas is high, and at present, a loss will be incurred since the present sale price of coal gas used by urban residents is lower.

2. Two-stage Gasification Furnace

This type of gasification furnace is also called the GI gasification furnace. The inside of the furnace is divided into two stages. Via some structural and technical measures, the upper part of the gasification furnace performs dry distillation and produces coal gas with a thermal value of 6,000 kilocalories/-cubic meter of standard coal after cracking. The lower section mainly performs gasification. It utilizes heated coke moved from the upper part to produce aqueous coal gas and mixes it with the dry distilled coal gas to yield coal gas of a medium thermal value of about 3,000 kilocalories/cubic meter of standard coal.

This type of gasification requires basically the same raw coal as that required by pressurized gasification and removal of solid residues. Bituminous flame coal or non-caking and slightly caking bituminous coal are most suitable.

The advantage of this type of gasification furnace operating under ordinary pressure is that it does not require oxygen producing equipment. The investment is small and construction is fast. But, the output of this gasification furnace is small and it requires the use of lump coal. The content of carbon monoxide in the coal gas produced is high. The thermal value is lower than that of coal gas produced by the furnace used for pressurized gasification and removal of solid residues. Generally, the coal gas produced undergoes measures to increase its thermal value so that it can be raised to 3,500 kilocalories/cubic meter of standard coal. This type of gasification furnace is suitable in cities which use less amounts of gas or as a supplementary source of gas.

3. Manufacturing Gas by the Coking Furnace

The method of using a coking furnace to heat coal involves dry distillation of coal inside the furnace to produce coke and coal gas. It is called manufacturing gas by the coking furnace. The final temperature of heating in the coking furnace is 900 to 1,000°C. The thermal value of the coal gas produced by the coking furnace is generally 4,000 to 4,400 kilocalories/cubic meter of standard coal. This technology is more mature, and our nation has already used it to produce metallurgical coke. Because coal gas is a by-product of this technology, the cost of production is basically borne by the main product --coke, therefore the price of coal gas is low and the content of carbon monoxide is small, and it is safer.

The coking furnace has a higher demand on the raw material. The coal supply must be fine coal suitable for coking to produce coke of a definite strength. From the point of view of gas production, the output of gas by the coking furnace is small. Each ton produces about 300 cubic meters of gas, and the coking furnace itself uses up half as fuel.

4. Continuous Vertical Carbonization Furnace (Wood's Furnace) to Manufacture Gas

This technology is similar to that of the coking furnace, but the dry distillation temperature is slightly lower. The output of coal gas is slightly more, reaching 360 cubic meters/ton of coal, and the thermal value of the coal gas is 3,900 kilocalories/cubic meter of standard coal. This technology uses a part of the coke produced itself to manufacture coal gas of a low thermal value for the generator furnace as heating fuel for the coking furnace.

The continuous vertical carbonization furnace produces mainly coal gas and does not have a strict requirement for the type of coal. Generally, lesser quality coking coal such as weak caking gas coal and singular types of coal can also be used. This method requires a small investment. The period of construction is short, and operation is simple. But, the technology and technique are relatively out-dated, and the coke produced is of poorer quality.

To increase the output of urban coal gas, some of the coke produced by Wood's furnace can be used to manufacture aqueous coal gas which can be mixed with the coal gas of Wood's furnace. This technology is more suitable for medium and small cities or as a supplementary source of gas in large cities.

III. Several Policy Questions Concerning the Development of Urban Coal Gas

1. Plan the composition of civilian fuel in cities well

It is not possible for any city to use only one type of fuel to solve its own energy problem. A rational composition of fuels must be planned according to the resources of the locality and the situation of consumption. Civilian fuel should also be planned rationally.

Generally speaking, cities are regions where the urban population density is high and where buildings are more concentrated. The number of tall buildings in medium and large cities is increasing year after year. Laying a network of pipelines in these areas to transport coal gas is the most suitable and safest. Business and service industries in the city and some industries can use piped coal gas as the main fuel. The suburbs surrounding the cities where conditions are favorable can use liquefied petroleum gas. Areas where buildings are more concentrated can consider piped coal gas. More distant suburbs can use honeycomb briquets and coal briquets as the main fuel. Of course, civilian fuels cannot all be in arbitrary uniformity as described above because of the city's own layout. But the downtown areas of large and medium cities should use piped coal gas as the main fuel.

As for industrial fuel, electricity generation, casting and industrial boilers still have to use coal (or coke) directly for a long period in the future, but it would be better for some precision or high grade light industries and textile industries, and electronics industries to use coal gas in order to improve the production technology and to improve product quality.

2. It Is More Suitable to Use Coal Gas of Medium Thermal Value as Urban Coal Gas

At present, some nations use coal gas of a high thermal value about 8,500 kilocalories/cubic meter of standard coal as urban coal gas. Its advantage is that the content of harmful carbon monoxide is low. The efficiency of using pipes to transport the coal gas is high and the gas can be transported over long distances. Especially in nations where a network of natural gas pipelines has already been built, this type of coal gas of high thermal value can be directly introduced into the natural gas pipelines to supplement the deficiency in natural gas.

Combining the concrete situation in our nation, we believe it is more economical and rational to supply coal gas of medium thermal value of between 3,500 and 4,000 kilocalories/cubic meter of standard coal to supply nearby cities. Our nation has not built a nationwide network of natural gas pipelines. There is no need to add a set of expensive methanation equipment (constituting about 6 percent of the total investment in a plant for pressurized gasification and

removal of solid residues) and spend more energy (spending 10 percent to 15 percent more energy) to raise the thermal value of coal gas. Whether it is coal gas from coking furnaces or gasification, the coal gas of medium thermal value produced can be directly supplied to the cities for use after purification. Some of the cities of our nation have already been using such coal gas for many years and they prove that coal gas of medium thermal value is suitable. The stoves currently in use and the condition of sealed pipes can all assure safety even when the content of carbon monoxide reaches 10 percent. Therefore, using coal gas of medium thermal value which requires less expenditure as urban coal gas is more suitable.

3. Fully Utilize Presently Available Coal Gas from Coking Furnaces, Gradually Develop Coal Gasification Technology

The development of urban coal gas must insist on the principle of suiting measures to local circumstances and suiting measures to the type of coal to select the technology of gasification. In the near future, we should develop the potential, fully utilize coking furnaces to produce coal gas and increase the release and the utilization of gas from oil fields, gas from refineries and gas from mines to realize quick results without spending too much money.

Our nation currently produces 33,000,000 tons of machine processed coke a year and the coking furnaces produce 16 billion cubic meters of coal gas a year. Among our nation's coking furnaces, only a small number have used coal gas from blast furnaces or coal gas from coal gas furnaces for replacement and heating to provide more coal gas by coking furances. There are still a large number of coking furances that use their own coal gas for heating. If half of them can be changed to using coal gas from blast furnaces or coal gas from coal gas furnaces for heating so that the replaced coal gas from coking furnaces can be used as urban coal gas, then the needs of several tens of millions of city residents can be satisfied. In addition, the indigenous coking furances that still produce 10,000,000 tons of indigenous coke each year in our nation at present not only seriously waste resources, they also cause serious pollution, and they should also be quickly rebuilt. The coal gas produced by these coking furnaces is also very sizable.

Coal gas from coking furnaces is afterall the by-product of the coking industry. The development of the coking industry should mainly be determined by the resources of coking coal and the sale of coke products. We suggest that the coking furnaces be fully utilized because rebuilding the presently existing machine processed coking furnaces and changing the indigenous coke production production into machine processed coke production still have a great potential for producing coal gas from coking furnaces. But, we cannot use newly built coking furnaces as the means for developing urban coal gas at will. Some cities do not have local coking coal resources and they do not have a reliable market for coke but they are planning to build coking plants just to produce coal gas. This is not right.

In the long range view, we must develop gasification technologies for coal in a key way while fully utilizing the existing coal gas of coking furnaces. This should be the direction of development of urban coal gas.

Our nation has very rich coal resources suitable for pressurized gasification and removal of solid residues and two-stage gasification. The reserves of lignite alone reach 120 billion tons. There are also a lot of flame coal and non-caking and weak caking gas coal. They are all good raw materials for gasification. These two technologies have a large output. In cities deficient in coal, less coal can produce more coal gas. For example, a plant producing 1 million cubic meters of coal gas a day using pressurized gasification and removal of coal residues or two-stage gasification requires only 400,000 tons of bituminous coal. A coking furnace that produces the same amount of coal gas needs 1,200,000 tons of washed coal, equivalent to about 2 million tons of raw coal. Therefore, in regions lacking coking coal resources, we should mainly develop these two types of gasification techniques. Pressurized gasification and removal of solid residues is more suitable for manufacturing gas in large cities and two-stage furnaces are suitable for use in medium and small cities.

4. Rationally Solve the Two Economic Problems of Coal Gasification

Using the technology of pressurized gasification and removal of solid residues to establish urban coal gas plants has two economic problems which have to be solved. One is its large investment of building the plant, and the investment in laying the network of pipes is also large. According to estimates, the investment in a gasification plant to produce 1 cubic meter of gas a day is 120 to 150 yuan and the investment in laying the network of pipes is 100 to 120 yuan. If we build a gasification plant with a daily output of 1 million cubic meters, the total investment would be about 200 million to 250 million yuan. The second is that the cost is high. Because at present, the civilian coal gas mostly used in our nation's cities is coal gas from coking furnaces, the selling price is low. The coal gas produced by gasification plants uses a lot of steam and depreciation is high. The cost is higher than the price of the coal gas presently produced by the coking furnaces and there will definitely be a loss.

It is very difficult to lower the investment in building plants under present technical conditions. In the near term, we can only build the plants at key localities. The investment needed should best come from the locality with capital assistance from the state. For example, the capital needed to lay the network of pipes should all be borne by the locality while the capital needed to build the plant should be shared by the locality and the state. The enthusiasm of the locality and the central authority should be fully developed. This may help the development of urban coal gas.

The cost of producing gas from coal, according to estimates made by concerned departments, is as follows. If the price of coal is 18 yuan/ton, the cost of producing coal gas by a coal gas producing plant using pressurized gasification and removal of solid residues with a daily output of 1 million cubic meters is 0.072 yuan/cubic meter. When the price of coal is 27 yuan, the cost of coal gas would be 0.1 yuan. The cost is higher than the coal gas currently produced by coking furnaces and supplied to the cities mainly because the coal gas from coking furances is a by-product of the coking plant. The processing

cost during the coking process is mostly borne by the coke. The cost of the coal gas of the coking furnace and the selling price are lower. Therefore, in Beijing and such cities, using coal gas is cheaper than using liquefied petroleum gas, and using liquefied petroleum gas is cheaper than directly burning coal. In addition, depreciation of the coal gasification plant is large. It consumes a lot of steam, and this has increased the processing cost of coal gas. To develop urban coal gas, we must take measures to change this situation.

First, we must exert efforts to reduce the cost of coal gas. The main measure is to use low priced coal as much as possible, to utilize surplus energy and surplus heat of the plant itself so that external supply of electricity can be reduced, to utilize these surpluses to produce chemical by-products such as using some coal gas to produce methanol and to use the profit from methanol to underwrite the deficit in producing coal gas.

Second, we must also provide support in price policy. For example, urban coal gas can be priced by two pricing systems. Coal gas for purely civilian use can be sold at a price slightly lower than cost. The price of coal gas used by the industrial and commercial sectors and the service industries can be slightly higher than cost so that there will be a slight profit after cancelling out each other. In some cities where the price of coal gas is too low, if due to various reasons the price cannot be raised, the government should consider subsidizing the price. This type of subsidies to public users is also frequently used in our nation and in foreign nations.

In general, we must take effective measures to actually solve the problems of high prices and high production costs for urban coal gas before the development of urban coal gas can be pushed forward.

IV. Strengthen the Scientific Research in Coal Gasification

Foreign nations have already accumulated a long period of experience in the use of urban coal gasification plants for coal gasification but our nation still does not have a set of mature technology. Therefore, we must hasten our efforts to solve related scientific and technical problems surrounding the development of urban coal gas. Our main efforts should mainly be to quickly complete the trial production of the pressurized gasification furnace and removal of solid residues and the two-stage gasification furnace, quickly grasp the advanced techniques of coal gas purification and treatment of waste water. At the same time, we must establish small experimental pressurized gasification furnaces, perfect the intermediate experimental devices for pressurized gasification to provide a basis for designing and selecting the type of coal and the technological process for newly built coal gas plants.

Whether it is pressurized gasification and removal of solid residues or two-stage gasification, both consume a large amount of steam, both have a low efficiency, and both have difficulty in treating tar and waste water. Foreign nations are studying new second generation and third generation gasification techniques that have a high thermal efficiency, that have a broad adaptability

to the types of coal, and that produce less tar and waste water. We should also closely combine the actual needs in our nation to strengthen the study of new techniques of gasification. Pressurized gasification and removal of fluid residues is a new gasification technique that is developing more rapidly and which has produced visible results in foreign nations. Compared to the pressurized gasification and removal of solid residues, the output of gas is 3 times larger. The amount of steam used is 2/3 less. The amount of waste water produced is 3/4 less, and it is possible to gasify less active types of coal, lean coal and anthracite. We should take this type of new gasification technique as the key subject in research. In addition, when we consider that the output of end pieces of coal in our nation will gradually increase, we must also hasten the study of the new technique of directly utilizing pulverized coal to produce coal gas of medium thermal value. In this regard, studies being carried out include multiple fluidized bed gasification, fused residue fluidization and gasification, and catalytic gasification. Their progress should all be hastened to realize results earlier.

The research in coal gasification is difficult and lengthy work. At present, our experimental conditions and research strength are weak and they do not match the task. For this, we need to greatly beef up research strength, perfect experimental conditions, and actively develop international scientific and technical cooperation and exchange to hasten the progress of scientific research.

9296
CSO: 4013/6

COAL, OIL, GAS

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TITLE: "On the Biolithite and Its Oil Potential from Qixia Formation in Changxing, Zhejiang"

SOURCE: Jiangling SHIYOU YU TIANRANQI DIZHI [OIL AND GAS GEOLOGY] in Chinese Vol 2 No 4, 1981 pp 312-313

TEXT OF ENGLISH ABSTRACT: The Qixia Formation, outcropping on the flanks of the Meishan syncline in Changxing, Zhejiang Province, has a total thickness of 236.94 meters. It consists mainly of bioclastic limestone intercalated with two beds of siliceous rocks which were formed by chemical precipitation. This formation may be divided into five lithologic members from top to bottom: the Top Limestone Member (18.11 m); the Upper Siliceous Rock Member (24.48 m); the Chert-bearing Limestone Member (114.11 m); the Lower Siliceous Rock Member (24.04 m) and the Stink Limestone Member (56.20 m).

[Continuation of SHIYOU YU TIANRANQI DIZHI Vol 2 No 4, 1981 pp 312-313]

The limestone contains abundant fossils of many species, but lacks carbonate grains, terrigenous debris and sparry calcite cement. No rocks and sedimentary structures of supra-intertidal or evaporite facies are found. These features show a slightly restricted, subtidal, reducing and shallow-sea environment with low energy.

The biolithite contains plenty of organic matter with more than 3 percent organic carbon. This limestone, especially that of the Stink Limestone Member, is a good oil-source rock. Generally, the oil-storing conditions of the biolithite are poor, but the suite of sparite and granular biolithite in the upper part of the Chert-bearing Limestone Member in the Meishan-Dushan area can be considered a favorable reservoir. According to the infrared spectrum, the oil and gas are at a high degree of thermal evolution and oxidization.

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TITLE: "Geological Characteristics of Petroleum in Tarim Basin"

SOURCE: Jiangling SHIYOU YU TIANRANQI DIZHI [OIL AND GAS GEOLOGY] in Chinese Vol 2 No 4, 1981 p 340

TEXT OF ENGLISH ABSTRACT: The Tarim Basin is the largest inland basin in China, covering an area of about 0.56 m [million] sq km. Considerable work has been done in the past in petroleum prospecting and exploration, but it was mainly confined to the Kuqa and Southwestern depressions. Generally speaking, the basin has not been studied fully.

The author has made an evaluation of three aspects of the basin. First, based on stratigraphy data, the sedimentary and tectonic evolution of the basin has been described; the structural systems and divisions, as well as the features in the development of local structures, have been expounded from the viewpoint of geomechanics and traditional geology; an explanation of the main oil source beds, reservoirs and types of potential oil and gas traps has also been presented.

[Continuation of SHIYOU YU TIANRANQI DIZHI Vol 2 No 4, 1981 p 340]

Finally, the author suggests that the Tarim Basin would be a very promising area for oil and gas. According to the available data, it is pointed out that the oil and gas potential varies in the following descending order: the Southwestern depression, the Eastern depression and the Kuqa depression, the Central uplift and the Southeast fault-step area.

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TITLE: "The Prospect of Permo-carboniferous Coal-formed Gas* in North China"

SOURCE: Jiangling SHIYOU YU TIANRANQI DIZHI [OIL AND GAS GEOLOGY] in Chinese Vol 2 No 4, 1981 pp 349-350

TEXT OF ENGLISH ABSTRACT: The Middle Carboniferous-Late Permian strata in north China are characterized by complete development, widespread distribution, common existence of coal and more stable petrography and thickness. Coal rank ranges from gas coal to anthracite, predominantly the medium-high level metamorphic coal. Predicted reserves above 1000 m are estimated at 1.3 trillion tons. Based on a genetic rate of coal-formed gas of 250 M /T, the predicted genetic potential of coal-formed gas amounts to 325 trillion cu m. Because of the intense tectonic activity in this area, an accumulation factor of 1 percent is used for calculating. As a result, coal-formed gas can still amount of 325 trillion cu m.

[Continuation of SHIYOU YU TIANRANQI DIZHI Vol 2 No 4, 1981 pp 349-350]

The traps, formed during the Indosinian and Early Yenshanian movements in north China, are favorable to the accumulation and preservation of coal-formed gas. So far the following preservative forms of coal-formed gas have been recognized in this area:
1) the accumulation in the Permian and Triassic red beds overlying coal measures;
2) the accumulation in coal measures;
3) the accumulation in ancient weathering crust;
4) the accumulation in the Meso-Cenozoic sandstone;
5) the accumulation in the solution in water layer.

The prospecting and exploration for coal-formed bas should be in areas where the Triassic system is better developed and structural traps exist and where the depths of the top of coal measures are at 1000-4000 m, as in the Qinshui Basin, Jiyuan Depression and Baodin-Shijiazhuang-Xingtai-Handang-Anyang areas, etc.

* Coal-formed gas means the gas associated with a coal source.

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TITLE: "A Preliminary Application of Geomathematical Methods to Oil Prospecting in West Jiuquan Basin"

SOURCE: Jiangling SHIYOU YU TIANRANQI DIZHI [OIL AND GAS GEOLOGY] in Chinese Vol 2 No 4, 1981 p 358

TEXT OF ENGLISH ABSTRACT: After years of exploration, three oil fields, including the Baiyang River oil field, were discovered in the monocline zone in the northern part of the western Jiuquan Basin. Finding new oil fields is an urgent task facing us. Therefore, we have comprehensively studied the relationships of known oil fields with geological variables, such as reservoir structural residual value, thickness and its residual value, mean value of self-potential curve, frequency of sand bed, ratio of thickness of less permeable intercalation to total thickness of reservoir, and with the marginal slopes of these variables. It is demonstrated quantitatively that the oil pool in the middle and upper parts of the Huoshaogou Group (Eh_{2+3}) is mainly controlled by lithological and structural factors. The

[Continuation of SHIYOU YU TIANRANQI DIZHI Vol 2 No 4, 1981 p 358]

characteristics summarized here of the distribution of oil fields are as follows:

All known oil pools occupy the favorable structure positions in areas with positive residual values and with less permeable zones along updip formations. They may also be aligned as strings of beads in a northwesterly direction.

Based on this, it is suggested that drilling be carried out in eight promising blocks of four areas. Consequently, oil sand or commercial oil has been found in blocks A, B and C by test-wells, which shows that initial success has been achieved.

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TITLE: "On the Organic Geochemical Characteristics and Oil-source Correlations in the Tarim Basin"

SOURCE: Jiangling SHIYOU YU TIANRANQI DIZHI [OIL AND GAS GEOLOGY] in Chinese Vol 2 No 4, 1981 pp 359-368

TEXT OF ENGLISH ABSTRACT: By using some advanced techniques, the organic geochemical characteristics of crude oil and its possible source rocks in the Tarim Basin and their oil-source correlations have been studied and presented here.

It is pointed out that in the Tarim Basin the marine beds of the Upper Cretaceous-Lower Tertiary are a moderate source rock only; the Jurassic lacustrine formation is rich in organic matter and may be the best source bed in this basin, but it is distributed only in some local areas, such as the Kuqa and Kashi depressions; the Permo-Carboniferous system has a relatively low content of organic matter, but it is widespread and very thick. Therefore, it may be the best potential source bed for oil and gas among the three possible source beds in the basin.

The high-yield crude oil and gas in the continental Miocene of the Kekeya oil field are highly maturated and characterized by terrigenous origin, therefore the author

[Continuation of SHIYOU YU TIANRANQI DIZHI Vol 2 No 4, 1981 pp 359-368]

believes that they may migrate from Permo-Carboniferous source beds.

Some crude oil in the Kuqa depression is marked by marine origin, which shows that the Meso-Cenozoic in this area may contain some marine source beds.

9717
CSO: 4009/273

OVER 7 MILLION METHANE PITS NOW OPERATING

Beijing GUANGMING RIBAO in Chinese 5 Feb 82 p 2

[Article by Xu Fuxin [1776 4395 9515], Xu Huanfa [1776 3562 3127]: "Generating Electricity from Marsh Gas"]

[Text] Marsh gas is a combustible gas containing mostly methane. It is a new energy source that is cheap and clean. Developing marsh gas is one of the major ways to solve the energy problem in our nation's farm villages. For several years, our nation's development of marsh gas has progressed rapidly. The total number of marsh gas pits is now over 7 million. In farm villages in Sichuan, Zhejiang, Jiangsu, and Guangdong Provinces and the municipality of Shanghai, some communes and brigades use marsh gas to cook and for lighting and they have also built small marsh gas power stations and utilized marsh gas energy as power for threshing, food and feed processing, and tea manufacturing. They have created a new road of using "indigenous" methods to solve the problem of electric power in farm villages.

As scientific research in marsh gas develops, the Jiangsu Provincial Marsh Gas Research Institute, the Wujin Diesel Engine Plant, and the Wujin Electrical Motor Plant have jointly designed, manufactured and built our nation's first single fuel (solely marsh gas) experimental 8 kw power station fired by marsh gas. Thus, the use of marsh gas to generate electricity has progressed one step further on the original foundations.

There are many advantages in building small marsh gas power stations in farm villages and utilizing the gas as a fuel to generate electricity. First, marsh gas energy resources are widely distributed, the potential is great, and all places that have living creatures have raw materials for manufacturing and extracting marsh gas. Therefore, marsh gas is a kind of inexhaustible renewable energy source. Second, local materials can be utilized and costs can be cut. When building a marsh gas power station in the communes and brigades in farm villages, the raw materials for fermentation need not be sought outside. The equipment and the technology of building a small marsh gas power station and electrical power station are relatively simple, and management and maintenance are very convenient. Most communes and brigades can do it. According to surveys and comparisons, investment per kilowatt of power of a small marsh gas power station is only about 400 yuan, only one-half to one-third that of a small hydroelectric power station, and much lower than that of a wind driven, tidal or solar power station. The construction period of a small marsh gas

power station is short. It requires only several months to begin production and use, and basically it is not affected by changes in natural conditions. Using marsh gas mixed with diesel fuel for burning can also conserve 70 percent of diesel fuel.

China's land is expansive and its population is large. Bioenergy resources are rich. Practice shows that whether in farm villages or in cities, local manure, stalks, weeds, waste dregs and waste materials can all be utilized according to the actual situation of the locality to produce marsh gas to generate electricity.

9296
CSO: 4013/12

EXPERIMENTAL 50-WATT CONCENTRATOR-TYPE PHOTOVOLTAIC ARRAY DESCRIBED

Beijing TAIYANGNENG XUEBAO [ACTA ENERGIAE SOLARIS SINICA] in Chinese Vol 3, No 1, Jan 82 pp 98-102

[Article by Chen Shukang [7115 2885 1660], Li Shundi [2621 7311 0966], Zhu Jianshu [2612 1696 2885], Shi Wenzao [2457 2429 5679] and Li Guoxin [2621 0948 2946], Xinyu Electric Cells Plant, Shanghai: "An Experimental 50-Watt Concentrator-Type Solar Cell Array"]

[Text] Because concentrato-type photocells have increased the generating capability per unit solar cell are [1-5], they are able to replace relatively expensive photovoltaic surface area with relatively inexpensive optical surface areas, thus effectively decreasing the production costs of photovoltaic arrays.

The present article gives a brief description of an experimental 50-watt concentrator-type solar cell array developed by us.

Experimental Apparatus

The 50-watt concentrator-type solar cell array has the following main characteristics:

Nominal output power	50 W
Peak output power	$\geqslant$ 60 W
Optimal voltage range	11-13 V
Optimal current range	$\geqslant$ 4.5 A
Maximum wind load on operating array	Level 6
Maximum wind load on secured array	Level 10
Automatic tracking range	Solar position angle (around vertical axis), 180° Solar elevation angel (around horizontal axis), 90°
Average power consumption for tracking	2.2 W
Tracking sensitivity	Tracking suspended when brightness < 10,000 lux (automatic return to initial position at night)
Tracking precision	< 0.5° when brightness >30,000 lux

Fig. 1 is a photograph of the array, which consists of two wings holding the concentrator arrays, a support stand and reducing gear box, and a photoelectric automatic tracking control unit.

Fig. 1. The concentrator-solar cell array

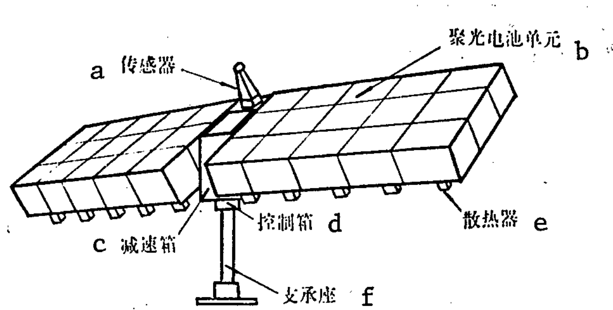


Fig. 2. Diagram of the array

Key:
a. Solar sensor
b. Concentrator cell
c. Reducing gear box
d. Control box
e. Heat dissipators
f. Support

The device contains two concentrator array boards placed on opposite sides of the support stand. Each of these boards is 1.5 m long and 0.9 m broad and consists of 15 concentrator units arranged in a 5 x 3 pattern in a supporting frame. The entire supporting frame is made of light aluminum alloy. Each of the cells is movable within the frame to adjust focal length and right-left or up-down position. The 15 concentrator cells are series-connected, as are the two arrays. Each of the wings is surrounded by thin sheet aluminum to decrease infiltration and damage by dust and sand. The dissipators use natural air cooling.

Each of the concentrator units consists of a Fresnel lens, a solar cell and an aluminum heat dissipator.

The Fresnel lens is cast from plexiglass (polymethyl methacrylate) and measures 260 x 260 mm, with a focal length of 280 mm and a concentration ratio of approximately 30.

The dolar cells are 36 mm in diameter and are made from heavily-doped p-type silicon monocrystals with an electrical resistivity of 0.3 ohm-cm. After the substrate undergoes high-temperature phosphorous diffusion to produce the p-n junction, it is photoetched to produce a radial grid pattern of 120 strips (Al-Ag contacts) each 50 microns broad, and an antireflective TiO_x film is evaporated onto the surface. With incident solar radiation of 100 mW/cm^2, each concentrator cell can produce 2.3 W or more.

The aluminum dissipators are the main components which moderate the temperature rise of the concentrators. These are multilayer radiators made from aluminum castings which are cemented to the solar cell with a special heat-conducting cement.

The support stand is equipped with a one-directional ball and socket thrust bearing, and the entire assembly can move freely around the vertical axis.

The fear box has a reduction ratio of 30,000:1 and consists of five reduction gear stages and one auxiliary worm gear. The operating principle is shown in Fig. 3. The vertical and horizontal axes each have a set of reducing gears, with the last stage consisting of a worm gear and worm shaft which increase the unit's ability to withstand brief heavy loads.

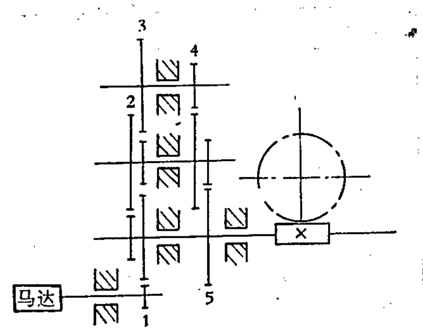


Fig. 3. Operating principle of reducer unit

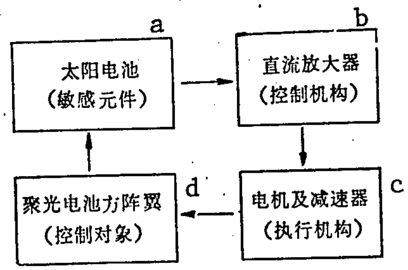


Fig. 4. Operating principle of photoelectric automatic tracking control unit

Key:
a. Solar cell (sensor)
b. DC amplifier (control mechanism)
c. Electric motor and reducer (actuating mechanism)
d. Wing of concentrator array (controlled object)

The photoelectric automatic tracking control unit consists of a sensor, a control box and an electric motor; a block diagram is shown in Fig. 4. A 2 x 2 cm n^+/p high-resistance (10 ohm-cm) silicon photovoltaic cell is used as the sensor element, which converts light signals into electrical signals. The difference signal following comparison is differentially amplified by the control element, a DC amplifier, after which it controls the actuating mechanism, a DC motor, via a switching circuit. The electric motor and reducing gear box actuate the controlled object, the concentrator array, allowing automatic tracking of the solar position angle and elevation angle. In other words, the control mechanism has two circuits, each controlling one DC motor to give "biaxial" tracking.

The solar sensor must assure production of a signal every time the direction normal to the concentrator array surface shows any deviation from the solar position angle and elevation angle. The unit consists of four solar cells separated by baffles, each of which can receive sunlight from only one direction. A sun shield is located at the top. When the sensor is correctly aligned to the sun, the sun shield throws equal shadows on all four cells, and the voltage from each pair of cells is zero. When the sun's position shifts, the shadow which it casts shifts in a specific way, and the two pairs of cells produce different potentials. In order to expand the collection range, the surface of the groups of photovoltaic cells is set at an angle of 45° to the vertical axis (rather than 90°) so that the array can perform tracking when the solar deviation is very large.

The control box contains two automatic tracking amplifiers for the two axes, a operating mode control switch, and an automatic nighttime return circuit. The operating principle of the axial control circuits is shown in Fig. 5. Two-terminal input and two-terminal output is used in the differential amplifiers, which have the advantage of a high common-mode rejection ratio, good stability, and small zero-point drift. The shaping amplifiers are added to convert the outputs of the differential amplifiers, which change linearly, to the square wave signals which are used to drive the final power output stage. For ease of care and maintenance, a switch for "automatic" and "manual operation" is provided. The array is automatically returned to the initial position during the night.

The motor is a miniature DC excitation motor with a working voltage of 12 V, a torque of 100 g-cm, an operating speed of 3,000 rpm and a working current of 0.6 A.

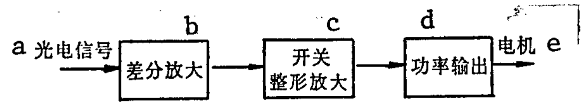


Fig. 5. Axial automatic tracking circuit organization

Key:
a. Photoelectric signal
b. Differential amplifier
c. Shaping amplifier
d. Power amplification stage
e. To electric motor

Experimental Results

1. Operation on 14 September 1980 in Shanghai produced the results shown in Fig. 6. The figure shows that when steadily irradiated with strong solar radiation (0900 to 1500 hours), the collector array was capable of producing more than 50 W.

The volt-ampere characteristic and optimal power point of the array are shown in Fig. 7. When the working voltage is between 10 and 13 V, the array produces an output of more than 50 W. When surface irradiation intensity is 73 mW/cm^2 (i.e. "direct radiation," and similarly below), the array's optimum actual output power was 92.9 W and the optimum working voltage was 11.5 V and the optimal working current 4.6 A.

At 2 PM on 17 September 1980, with a clear sky and surface radiation equivalent to 75-80 mW/cm^2, the array had a real output of 12.5 V, 5.2 A and 65 W. This is equivalent to a peak power output of over 80 W at 100 mW/cm^2 radiation.

2. Starting in mid-October 1980 the devices was tested in the Beijing area; a typical output curve is shown in Fig. 8. As the figure shows, in clear autumn weather in Beijing, during four hours of steady high-intensity irradiation (1000-1400), the array had a stable output of about 60 W.

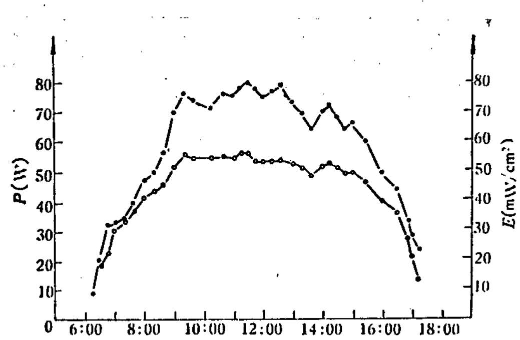


Fig. 6. Experiment conducted in Shanghai (14 September 1980), clear weather, thin cloud, light wind).

o = E-t curve ● = P-t curve

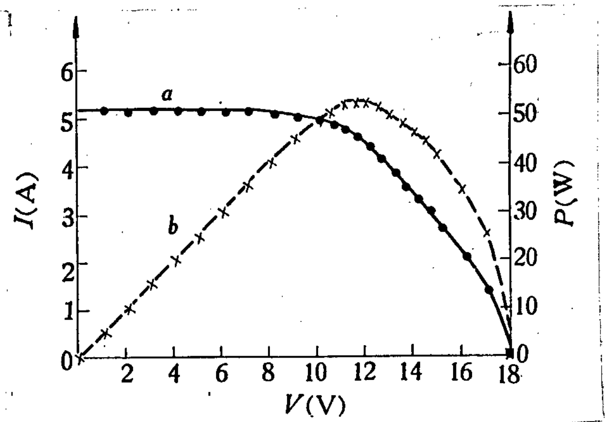


Fig. 7. Volt-ampere characteristic (a) and optimal power point selection curve (b). 1300 hours on 14 September 1980, solar radiation intensity 73 mW/cm^3, ambient temperature 37°C, array heat dissipator temperature 40°C.

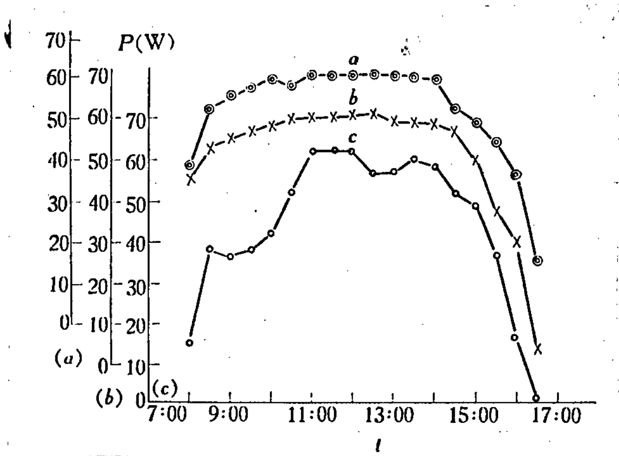


Fig. 8. Results of tests in Beijing. Radiation intensity about 90-92 mW/cm^2.

a. 30 October 1980 (clear weather)

b. 1 November 1980 (clear weather)

c. 3 November 1980 (partly cloudy to cloudy)

Discussion

1. The cost of the concentrator array is less than that of a flat plate array. As Table 1 shows, as the output power of each type of array is increased, the cost of the flat plate array is virtually unchanged, while the cost of the concentrator array decreases steadily.

Table 1. Estimated cost of concentrator type and flat-plate arrays

a 方阵输出功率(W)		50	100	200	500	1000
b 平板型	总成本 (元) d	6000	12000	24000	60000	120000
	成本(元/瓦) e	120	120	120	120	120
c 聚光型	总成本 (元) d	4000	6400	9000	13100	19100
	成本(元/瓦) e	80	64	45	26	19
f 聚光型成本/平板型成本(%)		66.6	53.3	37.5	21.8	15.9

Key:

a. Output power (W)
b. Flat-plate Array
c. Total cost (yuan)
d. Total cost (yuan)
e. Relative cost (yuan/watt)
f. Cost of concentrator array/cost of planar array (%)

2. The concentrator array has a higher output power than a flat-plate array. Fig. 9 shows the output power of the concentrator array with power consumption for tracking subtracted and the output power of a flat-plate device with the scattering effect added. In Shanghai at the fall equinox, the concentrator array output was 1.25 times higher than that for the flat-plate array with elevation tracking but no position angle tracking, and was almost 1.5 times higher than that for a flat plate array fixed in the horizontal position.

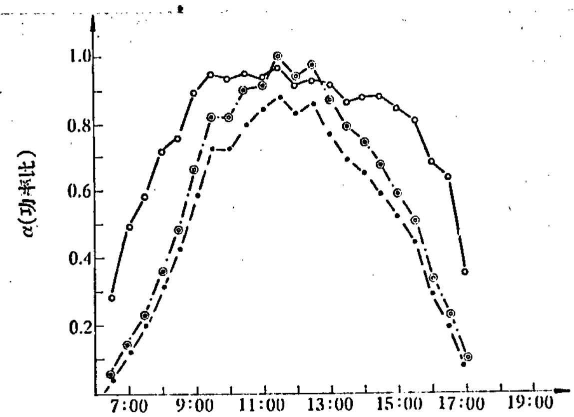


Fig. 9. Comparison of output power of concentrator and flat plate arrays (14 September 1980), Shanghai, clear weather)

O Concentrator type, automatic tracking

◎ Flat-plate type, focused on sun at noon, o no tracking

● Flat plate type, horizontal position, no tracking

The maximum output power q was 56 W, S_1 = 471.7 Wh, S_2 = 375.5 Wh, S_3 = 323.1 Wh.

3. It will be necessary to increase the reliability of the concentrator array further; only in this way will it be possible to assure that the array will be usable as a power source in extensive border regions and unpopulated regions without water or electricity.

Comrades Wang Xiaoming, Zhang Liyun, Wang Huajun, Jin Lihua, Zhang Conggang, Zhang Wenqi, Wu Xin and Huangfu Zhiqiang participated in the experimental work. We received energetic assistance from Comrades Huangfu Bingyan and Wan Jun of the Xinhua Lamp factory, Shanghai. We take this opportunity to express our thanks to all.

8480
CSO: 4013/14

COMMON SOLAR HEATING DEVICES DESCRIBED

Beijing XIANDAIHUA [MODERNIZATION] in Chinese, Vol 4, No 2, 16 Feb 82 pp 2-3

[Article by Tian Xiaoping [3944 1420 1627] of the Beijing City Solar Energy Research Institute: "Solar Energy Comes to You"]

[Text] Amid the cries of an "energy crisis" throughout the world, people have noticed that the sun sends to the earth about 6 billion x 100 million kilowatt-hours of energy a year. For thousands of years, people have attempted to utilize this enormous and inexhaustible natural resource. Laborers of the Zhou dynasty created a bronze concave mirror to focus sunlight to make fire. This was what ancient books recorded as the "sun flint." It was the world's earliest tool used to make fire by using solar energy. But the "heavenly fire" could only ignite moxa and such material. Today, "heavenly fire" can truly replace fuel to benefit mankind.

Solar Stove Being Developed

The solar stove is a tool for cooking rice, vegetables and boiling water by utilizing "heavenly fire".

Frequently seen solar stoves can be divided into two kinds, the hot box type and the light-focusing type.

The hot box type solar stove utilizes the principle of absorption by a black body. It continues to collect solar energy to reach a tempearture needed for cooking. It is actually a thermos with a transparent window and an air tight box whose interior is painted black. The window generally has two to three layers of glass. The glass allows sunlight to enter the box and the air between the layers of glass serves to insulate heat. This type of stove accepts a limited amount of solar energy and the interior of the box requires better heat insulation. The food that is to be steamed and baked is placed inside the box and it is cooked after a definite time. Some box type solar stoves also have reflecting mirrors to raise the temperature of the solar stove.

This type of solar stove has a good heat insulating layer and wind breaker, therefore it can utilize direct radiation and scattered radiation of the sun and it can also be used on cloudy days. But, because the temperature inside the box is only some 100 degrees and it is very difficult to reach over 200 degrees, the ways of cooking food are limited to boiling, steaming and baking but not stir frying.

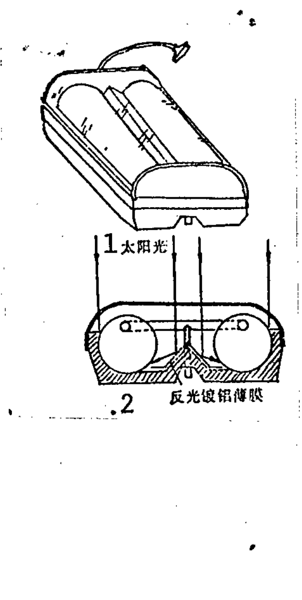
The light focusing type solar stove utilizes optical focusing by reflecting mirrors. They focus direct radiation of sun light onto the bottom of the pan containing food. If the reflecting mirrors can focus light to over 100 times, it would be equivalent to a regular stove heated by fire. The temperature at the bottom of the pan can reach 400°C to 650°C, suitable for boiling water, stir frying and cooking rice. But, its shortcoming is that it cannot fully utilize the scattered radiation of the sun, therefore it is difficult to use on days with light clouds and overcast days. When in use, its mirrors must be frequently adjusted so that the mirrors will face the sun. This limits its use.

Although the solar stoves have different forms and each has its own advantages, all are limited in use, all are affected greatly by weather, and all are unsuited to the traditional habits of cooking. Their widespread popularization is limited. At present, people are using certain modern techniques such as thermal tubes, selective coatings, automatic tracking devices and energy storage devices to transmit solar heat energy indoors for storage.

The Double Barrel Covered Type Water Heater

Introduced here is the small but versatile "BTR-3" model double barrel covered type household water heater (Fig. 3) developed by the Beijing City Solar Energy Research Institute.

This type of water heater has a new structure: A sheet of iron is zinc plated and made into into a double barrel to combine the heat collector and the water tank into one unit. A one-piece outer cover is made of foam polystyrene as a thermos. The transparent cover is made of plastic and it has a relatively high light permeability and it does not break easily. The central part inside the casing is convex and has an aluminum plated sheet attached to focus light. The light gathering area of this type of water heater is 0.55 square meters. The exterior dimensions are 1,105 x 605 x 265 cubic millimeters and it weighs only 8 kilograms empty. It can contain 63 kilograms of water and it is sold for 55 yuan. On clear days in the Beijing area from April to October, it can provide 63 kilograms of water heated to over 40°C (Table 1). This type of water heater does not have a water tank. Its installation is simple, its use is convenient and it is already in use in some families. In July 1981, a certain family used it to provide bath water for 7 persons.



Double barrel covered type household water heater

Key:
1. Sunlight
2. Aluminum plated reflecting sheet

Table 1 Test results of the double barrel covered basking type water heater (November 1, 1980)

Time	Average temperature of water (°C)	Surrounding temperature (°C)	Wind speed (meter/second)
9:20	17.4	12	4
10:20	22.4	13	5.4
11:20	27.4	14	5.4
12:20	32.4	15	4.6
13:20	36.7	15.2	3.6
14:20	40.25	16	4.6
15:20	42.1	16	4.4
16:20	42.5	15.5	2.2
17:20	40.7	14	2
18:00	39.6	13	1

Portable Plastic Solar Water Heater

The "GTR-4" portable plastic solar water heater developed by the Beijing City Solar Energy Research Institute is made of a double layer ethylene plastic with anti-aging chemicals added. The surface layer is transparent to facilitate direct penetration by sunlight. The back surface is black to facilitate absorption of solar energy. The water heater can last 2 to 3 years. The whole heater weighs less than 1 shi jin and when not used it can be rolled up and carried. The water heater has a handle, a plastic showerhead like the showerhead used for showers, a faucet, a tube and a water intake opening. When in use, it does not require any accessories. The total water content is 14 kilograms and it is sold for 4.5 yuan. It is a personal water heater that is good and cheap. We tested this type of water heater in May 1981. The test results showed that when the weather is clear and when the surrounding temperature is from 22°C to 28°C (from 11 am to 3:30 pm), the temperature of the water after basking under the sun for 2 hours can reach 37°C to 42°C and a high of 55°C.

The faucet of the water pipe must first be shut before using this type of water heater. Then the container is filled with water. After it is filled, the container opening is closed by a cap. The water heater is then placed at a sunny place such as the balcony facing the sun or the window still facing the sun with the transparent side facing the sun. To prevent absorption by the ground surface, it is best to place the water heater on a supporting board. When using the heated water, the heater is lifted up by its handle and the faucet is turned on. Heated water will flow from the showerhead for washing or bathing. In winter or when there is no sunshine, it can also be conveniently used for taking a shower after filling it with hot water.

9296
CSO: 4013/13

SUPPLEMENTAL ENERGY SOURCES

GENERATING ELECTRICITY FROM WAVES

Beijing JIANCHUAN ZHISHI [NAVAL AND MERCHANT SHIPS] in Chinese, No 12, Dec 81 pp 18-19

[Article by Tong Menghou [4547 1322 0186]: "Waves Create New Energy -- Brief Discussion of the Buoy That Generates Electricity From the Forces of Waves"]

[Excerpts] The movement in 1 square kilometer of waves generates energy equivalent to 200,000 kilowatts per second. It is a pity that this kind of inexhaustible natural energy source has become useless drops of water for so many years.

In recent years, as scientific technology continues to develop, people have gradually turned towards the ocean in developing new energy sources to let the oceans contribute their treasures to continue to benefit mankind. Now, people have conducted a lot of research and have utilized the forces of waves. Many ocean energy power stations have been built along sea coasts. A new vessel that is run by electricity generated by a turbine driven by waves has made a trial voyage. Navigation buoys that utilize the forces of waves to generate electricity are more common.

In China, the use of the forces of waves to provide a source of energy for navigation buoys already has a history of several decades. When heavy snow falls over the ocean, or when heavy clouds cover the sky, when ships cannot see any object several meters away, there is a special pear-shaped buoy placed near reefs in the ocean. Ships rely on the sound it emits to judge their own position and decide the course they will sail. The pear-shaped buoy is also called a whistle buoy or a fog siren buoy (Figure 1). It has a whistle installed on its buoyant barrel. The buoyant barrel moves along with the waves, rising and falling. In this way, water compresses the air inside the barrel. The air is released through the whistle on top of the buoyant barrel and makes a sound.

The utilization of the forces of waves by the whistle buoy has given people a prodound inspiration: The energy of waves can be converted to air energy. If the air energy can be converted to electrical energy and used on a light buoy then it would have more value. After many years of efforts, this wish finally became a reality. Japan has placed buoys powered by electricity generated by the forces of waves at 400 to 500 places in its territorial seas and has sold this new device to Britain, the United States and Sweden.

The navigation light powered by electricity generated by the forces of waves consists of a buoy, an air cylinder, an air turbine, valves, a generator and a controller. Its working principle is as follows: The buoy on the ocean surface moves up and down with the waves and the movement causes the air pressure inside the air cylinder to change. This pressure drives the air turbine that generates electricity (Diagram 2). When the buoy is at the crest of the waves, the water level in the central air pipe moves downward correspondingly. Under this pressure difference, the $valve_1$ and $valve_3$ automatically shut. The atmospheric air enters the spout through $valve_4$ and drives the turbine generator, causing it to rotate. The air then enters the central air pipe through $valve_2$. When the buoy is at the wave trough, $valve_2$ and $valve_4$ shut under the action of the pressure difference. The air inside the central air pipe flows into the spout through $valve_1$ and drives the turbine generator to continue to rotate and then the air is released into the atmosphere through $valve_3$.

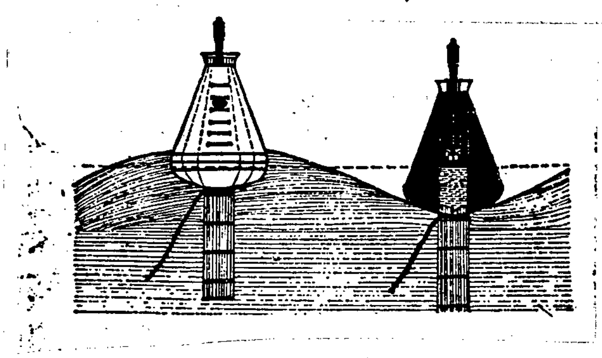


Fig. 1 Whistle Buoy

Waves occur constantly in the open sea. This enables the turbine inside the buoy to continue to rotate and produce electrical energy. The alternating current generated by the generator passes through a full wave rectifier and charges the battery (the battery used is a low efficiency lead acid battery with a small self consumption). This provides a continuous supply of electricity to the navigation light. This type of light buoy powered by electricity generated by the forces of waves enables its turbine generator to generate electricity normally as long as the height of the waves is 40 centimeters. The output power can reach 50 to 60 watts.

Generation of electricity by the force of waves can be used to power lights on buoys, then can it be used to power light houses? According to reports, foreign nations have already applied the principle of generating electricity for buoys using the forces of waves in powering light houses and have built fixed devices for generating electricity using the forces of waves. According to calculations, the force of tides against the coastal rocks near light houses can reach 30 tons/square meter. The striking force of waves against light towers in open sea can also reach 15 tons/square meter. The fierce waves once crushed a light house several dozen meters above sea level in the Bay of

Bengal. To avoid destruction, the fixed device for generating electricity using the forces of waves has several intake floodgates. When a giant wave rushes towards one intake floodgate, this intake floodgate is closed and another is opened. This type of electricity generating device can produce an output power of up to 120 watts.

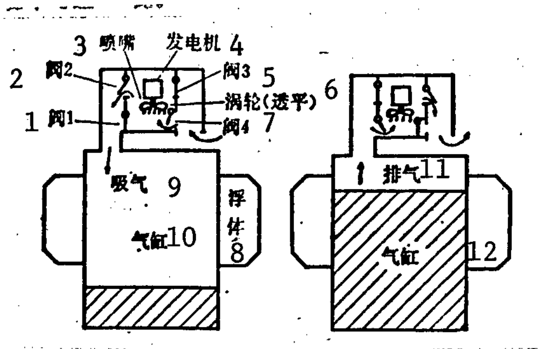


Fig. 2 Working principle of the light buoy powered by electricity generated by the forces of waves

Key:

1. Valve
2. Valve
3. Spout
4. Generator
5. Valve
6. Turbine
7. Valve
8. Buoy
9. Air intake
10. Air cylinder
11. Air exhaust
12. Air cylinder

The equipment using the forces of waves to generate electricity for navigation marks, compared to other forms of energy sources (such as forces of wind, solar energy) is small, the structure is simple, the efficiency is high, the cost is low and it does not release pollutants. An ordinary light buoy requires only slight modification and installation of a turbine generator to become a light buoy powered by the forces of waves. If the navigation buoys can widely utilize this kind of modern device to generate electricity by the forces of waves, then the batteries and bottled gas used as energy sources can be replaced. It can guarantee normal lighting of the navigation buoy and it does not require people to change those heavy and inconvenient batteries and bottled gas at fixed intervals.

During this century, scientific research personnel of each nation have conducted many types of scientific research in utilizing the energy of waves in the ocean and on the sea coast. Several hundred ideas have been proposed but most plans are still in the experimental stage. Generating electricity using the forces of waves can be utilized first in navigation buoys because the power of electricity generated by the forces of waves is relatively small and because navigation lights operate only during the night and the amount of electricity needed is not large.

The navigation light buoy powered by electricity generated by the forces of waves built by our nation ourselves has been tested indoors and in the ocean and preliminary success has been realized. It will join the ranks of other types of navigation buoys and will shine along the ten thousand li of navigation routes of our nation.

Of course, utilization of the forces of waves for light buoys is only one step towards the development of the energy resources of the oceans. As mankind's production and living standards continue to increase and improve, energy consumption will continue to increase. Research and development of natural resources will strengthen. The 1.37 billion cubic kilometers of sea water will become available and will welcome the new forces in the development of new energy resources.

9296
CSO: 4013/15

WORKSHOP ON UTILIZATION OF MARINE ENERGY HELD AT GUANGZHOU

Beijing NENG YUAN [JOURNAL OF ENERGY] No 1, 25 Feb 82 p 4

[Article by Sima Chen [0674 7456 5256]: "Workshop on Utilization of Marine Energy Held at Guangzhou"]

[Brief] From 1-3 December 1981, a workshop on utilization of marine energy was held in Guangzhou by the Chinese Society of Marine Engineering. Ninety-two delegates representing 59 units participated. Forty two papers were presented. These papers covered wide range of topics including development of marine energy all over the world, present status of marine energy utilization, and China's experience in the field of marine energy utilization. Some papers were of very high technical standard and some research results were considered by the participants of the workshop to be quite significant.

The so-called marine energy system includes thermal energy resulting from the temperature differential that exists between the upper and the lower layers of the ocean; mechanical energy resulting from the movement of sea water such as tide, ocean current, and wave; and chemical energy resulting from the salinity differential that exists between the fresh river water which empties into the ocean and the sea water. Marine energy is characterized by its renewability, free from pollution, wide distribution, and low energy density.

The Chinese mainland has a long coastline; more than 1,800 kilometers of shoreline and 4.88 million square kilometers of oceanic region with relatively rich marine energy resources. According to a preliminary estimate, the exploitable marine thermal energy resource is approximately of the order of 1 billion kilowatts, and the tidal, wave, and salinity differential energy resources are each of the order of 100 million kilowatts. These resources are definitely worth exploiting. Those projects which are actually under way today include Ganzhutan Tidal Electric Power Station at Shunde, Guangdong and Jiangxia Tidal Experimental Electric Power Station at Wenling, Zhejiang. A number of effective research and experimental efforts related to the development of wave energy and current energy have also been started. However, generally speaking, China's efforts to develop and utilize marine energy is only in its infant stage and its foundation is rather weak. The participants wish that the concerned governmental department in charge will further strengthen the leadership on matters related to research and development of marine energy by including the utilization of marine energy as part of the short- and long-range plan of the Energy Committee, National Science and Technology Commission. For the

time being, we should start out with small-scale projects including utilization of marine energy in the form of tides and waves to generate electricity for navigational markers, buoys, and lighthouses. If the conditions are favorable, medium-scale tidal electric power station of 10,000-kilowatt class may be constructed and the research and utilization of temperature differential electric power generation may also be undertaken. At the same time, scientific exchanges and compilation of technical information and systematic survey and evaluation of marine energy distribution should also be undertaken to lay down the ground work for future large-scale development and utilization of marine energy.

9113
CSO: 4013/50

FUZHOU GEOTHERMAL RESOURCES PUT TO PRINCIPAL USE

Beijing GUANGMING RIBAO in Chinese 5 Feb 82 p 3

[Article by Chen Youren [7115 2589 0088]: "Fuzhou Successfully Develops a Refrigeration Facility Utilizing Geothermal Energy"]

[Text] The Fuzhou City Energy Utilization Research Institute, the Fuzhou University and the Fuzhou Refrigeration Plant jointly developed a refrigeration facility utilizing geothermal energy--"the experimental bilevel ammonia absorption type hot underground water refrigeration facility." On December 20 of last year, the Fuzhou Provincial Science Committee held an evaluation meeting. Experts agreed that the facility has met the designed requirements. This was the first successful attempt in our nation to utilize medium and low temperature hot water for refrigeration. This is an important new scientific research achievement in the utilization of geothermal energy and it has opened a new path in utilizing geothermal water of low potential energy.

Fuzhou City has a rich reserve of underground hot water. How to utilize geothermal energy to develop industrial production is a problem facing the broad masses of scientific research personnel that needs to be solved urgently. The Fuzhou City Energy Utilization Research Institute, the Fuzhou University and Fuzhou Refrigeration Plant began in 1974 to explore the utilization of geothermal energy for refrigeration according to the task assigned by the provincial science committee. They studied information on the refrigeration facilities in the nation and abroad, and developed a "bilevel ammonia absorption type experimental facility for refrigeration using underground hot water" which utilizes ammonia as the refrigerating agent and water as the absorbing agent. In January, 1980, the facility was successfully test run. During more than one year of operation, modification and tests, the facility's performance has now reached the designed requirements. The facility can refrigerate up to 45,000 kilocalories per hour while consuming less than 9 kilowatt-hours of electricity. Compared to facilities with the same amount of refrigeration and the equipment for refrigeration using ammonia compression under evaporating temperatures, it can conserve about 65 percent of electricity. The Fuzhou City Energy Utilization Research Institute has already used it to produce ice. This has supported the needs of guaranteeing freshness of export-oriented vegetables in Fuzhou City, and it has also conserved electricity. The refrigeration is also suitable for freezing, air conditioning, preserving freshness of vegetables, cultivating edible fungi and food processing. The hot water released from refrigeration can reach nearly 80 degrees centigrade. The hot water circulates in pipes and is not lost. It does not pollute and it can be used comprehensively for other purposes.

9296
CSO: 4013/12

GREAT POTENTIAL SEEN FOR DEVELOPING QINGHAI'S WIND POWER RESOURCES

Beijing GUANGMING RIBAO in Chinese 11 Apr 82 p 1

[Text] Engineer Dai Jiaxi's scientific paper on the utilization of wind power has recently won an award. In the paper he points out that Qinghai's abundant wind power resources have broad prospects for development.

Dai Jiaxi is an engineer with the Qinghai Provincial Weather Bureau. He has conducted statistical analyses on more than 4 million pieces of data from the province's more than 50 weather stations. His scientific research paper won the province's award for the most important scientific achievement on 11 Mar 82.

Based on experience in using the energy of the wind in various places, areas with a yearly average wind velocity of 3 meters per second have a potential for development.

Qinghai Province has many areas that meet or exceed this standard. Tanggula Shan and other regions have the most abundant wind energy resources in China.

More than 90 percent of the area of Qinghai Province has wind for more than 4000 hours per year and areas in the western part of the province may have wind for 6000 hours per year.

Dai Jiaxi's paper basically determines the province's wind power reserves and their patterns of fluctuation, providing the scientific basis for their development and utilization. It is the first major research paper on Qinghai's wind power resources.

Dai Jiaxi idea for the exploitation of Qinghai's wind power resources is: 1) the selection of the proper windmill model suited to the special conditions of the winds in Qinghai; 2) to undertake experiments on the relationship of windmill power and the altitude above sea level; and 3) to conduct studies on the combined use of wind power and solar power.

CSO: 4013/60

CHINA'S LARGEST WIND-POWERED POWER STATION

Beijing DILI ZHISHI [GEOGRAPHICAL KNOWLEDGE] in Chinese, No 2, 1982 p 15

[Article by Cai Ziming [5591 1311 2494], Luo Yuefang [5012 1471 1496]: "Wind-powered Power Station at Shaoxing"]

[Text] At Shaoxing, in Zhejiang, the home village of Lu Xun, our nation's largest wind-powered power station at present has been built. Its installed capacity is 18 kilowatts, equivalent to the amount of electricity used by 200 families each lighting one large 90-watt lightbulb!

Wind energy is an inexhaustible natural energy. Compared to coal and petroleum, it can be easily collected, its price is low and it does not pollute. It is one of the most attractive new energy resources in the world at present. Therefore, in recent years, all nations are competing to develop it. Our nation has also conducted active research work in this regard and has built a number of test facilities.

The Shaoxing Wind-powered Power Station stands on top of the Xionge Peak on Kuijishan. This mountain peak is about 50 kilometers from Shaoxing and is about 800 meters above sea level. The potential of wind energy is large. The annual average wind speed is 4.5 to 5 meters per second, with highs reaching 28 meters per second. It is suitable for installing windmills.

Preparation for the construction of the wind-powered power station at Shaoxing began in June, 1970. Construction was completed in 1971. The power station began generating electricity officially on July 9 that same year. The tower of the power station is 12 meters high. The diameter of the pinwheel is 13 meters. With a wind velocity of 8 meters per second, the pinwheel turns 64 times a minute. The rotary speed is raised to 1,000 cycles per minute via a mechanism connected to a generator to generate electricity.

After many years of operation and tests, some scientific research data have been obtained. To expand the scope of its utilization, not long ago, this wind-powered power generating installation was moved to Shengsihaidao to continue measurements of its performance in operation and to provide even more data for research in the generation of electricity by wind power in our nation.

9296
CSO: 4013/55

WIND ENERGY UTILIZATION IN CHINA

Beijing TAIYANGNENG [SOLAR ENERGY] in Chinese No 1, 28 Feb 82 pp 10-11

[Article: "A Glimpse of China's Wind Energy Utilization"]

[Excerpts] Around Lixiahe and Taihu in Jiangsu and in the vicinity of Shanghai and Songjiang area, utilization of wind power for irrigation has been very successful, and the practice continues today. In 1957, in the Yanchen area in Jiangsu alone there were nearly 100,000 wind mills used for agricultural applications and approximately 3 million mu of land were irrigated. In Xinhua County, Jiangsu Province, the history of irrigating fields with water pumped by the windmills is also quite long and the farmers have extensive experience with windmills. The structure of the windmills has been improved continuously over the years with the development in production. During the 19th century, large-scale windmills were in fashion. Wind vanes, 10 in number, were woven from reed grass and rotated around a vertical axis, so the windmill could function no matter which way the wind blew. However, its wind energy utilization rate was low, so it faded away gradually in the early days of this century. Later on, simple windmills having a horizontal axis, which are simpler in construction and lower in cost, (such as the rolling drum type, the chain windmill, etc.) became popular. These windmills, however, have low transmission efficiency and cannot withstand the force of a gust of wind. It tends to topple over quite easily and it is capable of pumping water only enough to irrigate some 10 mu of field. During the 1940's, six-sail mills became popular again. The six sails of this windmill are made of cloth and each stretched over a bamboo rod. The sail is easily raised or lowered, so the speed can be adjusted manually. Two pairs of transmission gears transfer the rotational motion of the blade axis via a vertical axis to an output axis which drives a water pump. Each time the wind changes its direction, an A-frame has to be moved manually so that the wind turbine may face the wind. This wind turbine is simple in construction, low in cost (approximately 100 yuan) and its wind energy utilization rate, its transmission efficiency, and its ability to withstand gusts are all better than the previous windmills. Water pumped by this device is sufficient in quantity to irrigate 30 mu of fields.

Although China was one of the first nations in the world to utilize wind energy, it was late in undertaking modern scientific research work, so the structure of its windmills has not changed appreciably over centuries. Research and development of new types of wind power machines was started only in the late 1950's.

At that time, a number of wind power research laboratories were established within a number of research institutes and a group of scientific personnel undertook the theoretical research and design work related to wind power machinery.

In 1957, a 66-watt wind power generator was successfully trial manufactured in Baicheng, Jilin Province. Since then, small-scale wind power generators ranging in size from several hundred watts to several thousand watts have been developed one after another in various parts of China including Jiangsu, Anhui, Liaoning, and Xinjiang. These windmills have diameters no more than 10 meters and their blades are made of either wood or metal.

In 1963, Xinhua County, Jiangsu Province, in cooperation with concerned units, developed a high-speed wind power machine--the DJX6 wind power generator--and a low-speed wind power machine. Ever since it was installed, the high-speed wind power machine has been running normally and generating power safely. This type of wind machine can supply enough water to satisfy the need of 120 mu of field. The investment, amounting to 2,600 yuan, can be recovered completely in 8 years.

Since 1958, experimental work on the utilization of wind power has been under way in the grazing areas of Xilin Gol league of Inner Mongolia. In 1969, wind power generators provided lighting within Mongolian tents for the first time and wind power operated pumps providing water for man and beast. An FT-183 wind power water pump installed in 1976 in the Hanula commune of Abag banner has been running smoothly ever since, supplying drinking water for 200 head of cattle, 1,500 sheep, and a family of three. The commune has also installed a 100-watt wind power generator which provides many shepherds with electric light. In 1981, Xilin Gol league installed 14 wind power generators at a test site in Gongbulag commune and thus insured a sufficient supply of water for the trees as well as grass within the corral. The Huabei pines planted here in 30 mu of land had a 90 percent success rate.

In December 1978, a wind power water pump was installed in Alashan left banner of the Nei Monggol Autonomous Region. This unit consists of a wind power generator and a pull rod pump. This machine is of the direct drive type, and is attended by a single person. It supplies drinking water for 4,200 sheep. This type of pump can be fitted with pull rod pump of different capacity according to the well depth. It has a simple construction and is easy to operate. The cost of supplying drinking water to a given number of sheep by this pump is cheaper than the cost of supplying water by camel power, and much cheaper than the cost of supplying water using pumps powered by diesel engines. Assuming that the number of sheep that can be watered by a single well is 2,400, then the annual cost of water per sheep will be 0.34 yuan cheaper by this wind powered pump than by camel power, with an annual saving of 816 yuan.

Over a period from March to December 1979, the Bain commune of Zhong Hou banner, Nei Monggol, carried out an experiment of popularizing 23 compact wind power generators having a capacity of less than 30 watts in order to supply electricity for daily life for the shepherds at their dwelling, providing power for 15-watt light bulbs for illumination and electricity for charging batteries used in transistor radios and flashlights. Each wind machine is equipped with

a 100 ampere-hour storage battery which, when fully charged, can supply electricity for 5 hours each day for 6 days even if there is no wind. These units have definite practical value because of their many attributes, including low cost (only 300 yuan per kit which includes lighting equipment and storage battery), low starting wind velocity, and adaptability.

According to statistics, by 1980, altogether eight different types of wind power water pumps were developed and 381 units had been manufactured in the Nei Monggol Autonomous Region, of which 87 units have been installed within the region. Five different types of wind power generators were developed and 292 units had been manufactured, 227 of which have been installed within the region. Wind power generators having 500-watt, 2.5-kilowatt, and 5-kilowatt capacities and wind power water pumps having 6 m and 2.5 m diameters are being researched and developed. New types of 100-watt wind power generator are being developed on the foundation of the original 100-watt wind power generator assembly. At present, the total number of units in operation is 50 percent of the number of units installed.

In 1977, an 18-kilowatt wind power generator was installed on top of Dongshan in Caiyuanzheng, Shensi County, Zhoushan Islands, Zhejiang Province. This unit consists of the blades, a gear box, a centrifugal hydraulic governor, a brake, a generator, a tail rudder, a rotating flat platform, a steel tower, a switchboard, a manually operated oil pump, and an equipment housing. Its gear box, centrifugal hydraulic governor, and generator are grouped together and installed at the top of the tower. This unit can generate electricity if the wind velocity is greater than 4 meters per second, and the rated 18 kilowatt power can be delivered at a wind velocity of 10 meters per second or more. It is currently used for the purpose of supplying power for a number of operations including sea water desalination, illumination, pumping water, and electric welding. On 10 April 1981, the service was extended to Caiyuan fishing unit and the customers are very satisfied. This unit is also equipped with an automatic switching device. When the wind machine output voltage is greater than 300 volts, the power is supplied by the wind machine, but if its output voltage is below 300 bolts, the power is supplied by the electric power network. Its tower is 16.9 meters tall.

A wind power generator assembly developed by the Central Meteorological Bureau's Scientific Research Experimental Plant especially for use at remote high mountain meteorological stations, after numerous improvements, is being operated and tested continuously at the Wutaishan meteorological station in Shanxi Province.

Badaling Wind Power Generation Experimental Station is under construction in Xibozi Commune, Yanqing County, Beijing City. This location is "windy all year round" with an annual average wind velocity of 5 meters per second and gusts up to 7-8 class are common in winter. It is an ideal site for a wind power generation experimental station. So far, five units have been installed. Three of them were designed and constructed in China; the other two were imported from Switzerland and the United States. The smallest unit has a capacity of 1.5 kilowatt while the largest unit has 10 kilowatt capacity.

These five generator units and one anemometer tower are arranged in a straight line, and the bright red, blue, white and greencolors painted on the machinery assembly and tower gleam under the sunlight, attracting the attention of tourists who climb the Great Wall and thus adding new scenic spot to the Badaling scenic region.

There are quite a few organizations engaged in the research and development of wind power machinery in China today. However, the research level is rather low, especially in the area of wind power generator. It has not yet reached the level which deserves authentication and popularization. The research technique employed is also rather obsolete. In fact, many designs have not undergone wind tunnel test and, as a result, many problems cropped up when a prototype was test run. However, the prospect of wind energy utilization is sufficiently bright, because compared with other new energy sources utilization of wind energy requires relatively simple equipment and smaller investment. Therefore, we must strengthen planning and constantly improve the research level so as to be able to better utilize wind energy in service of the four modernizations.

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